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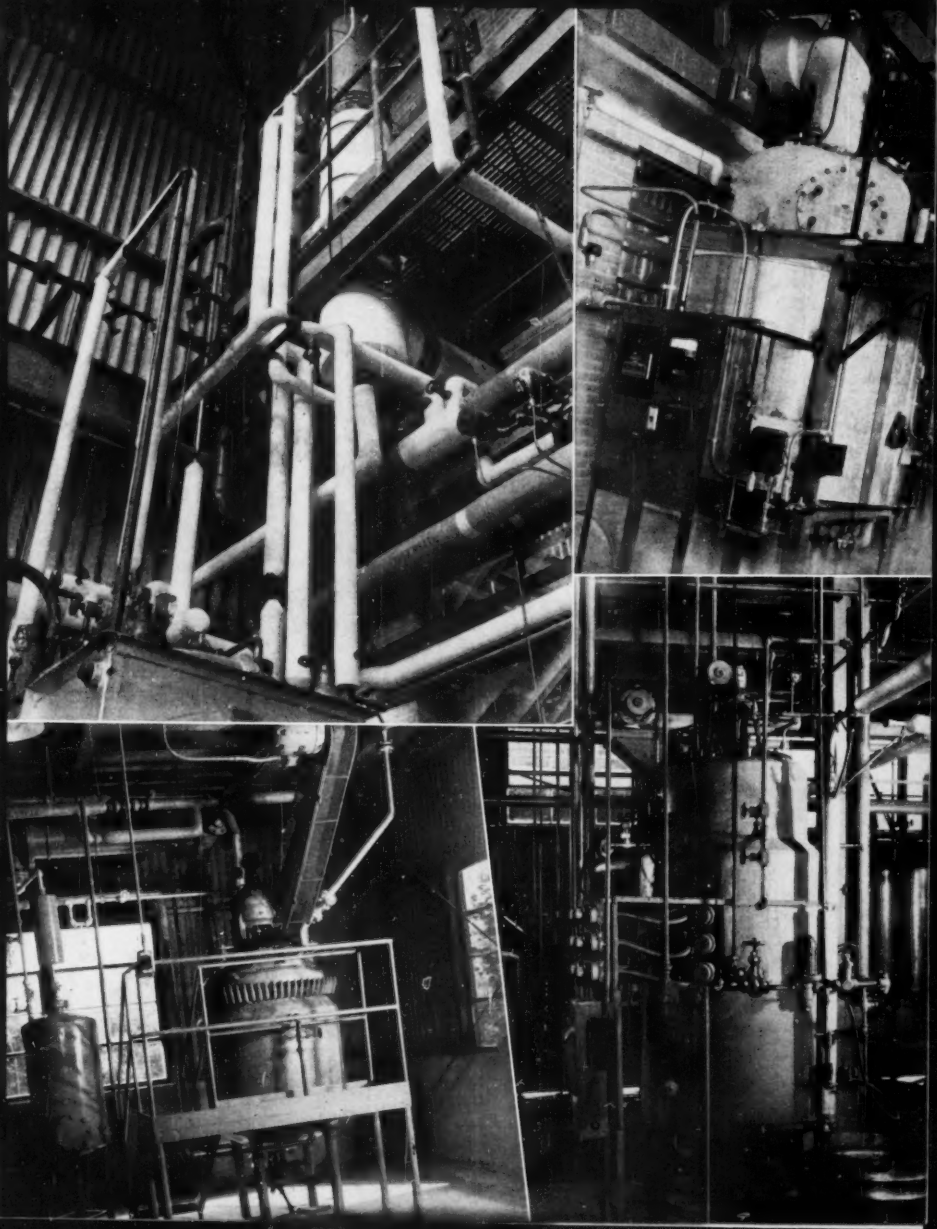

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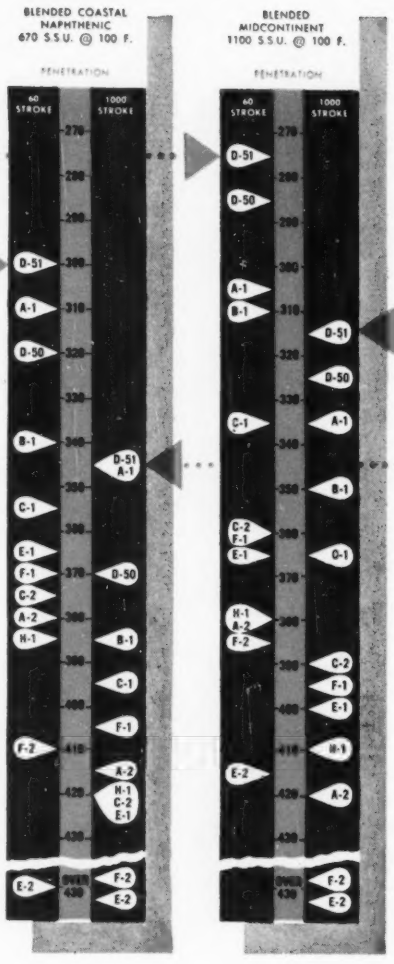

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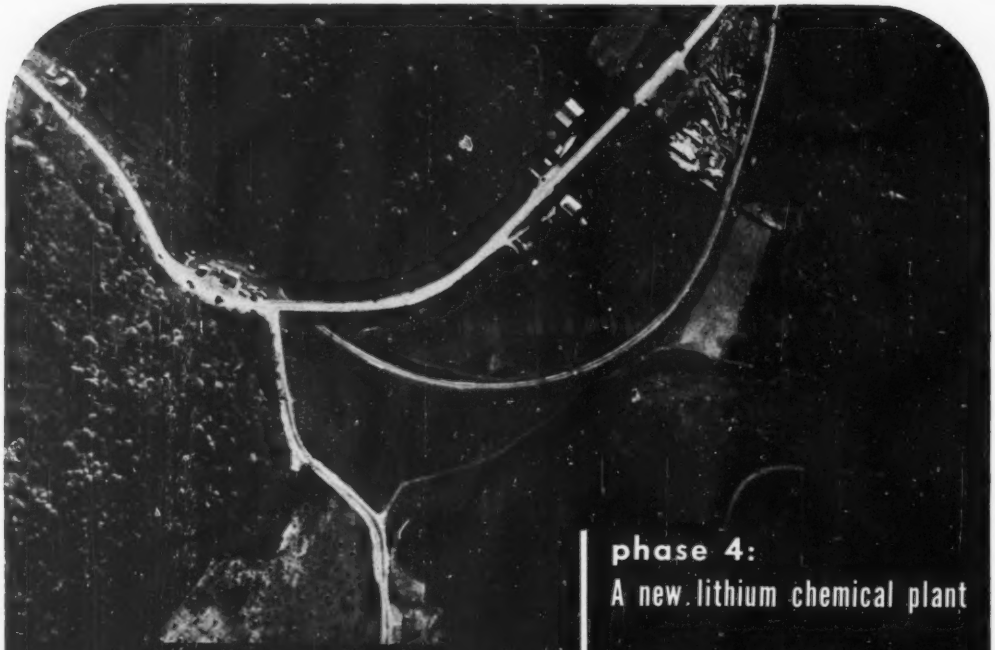

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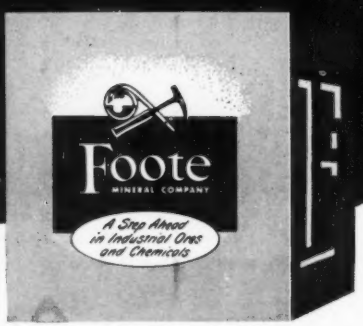

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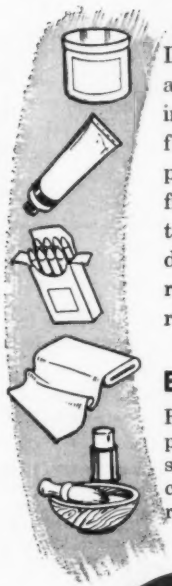

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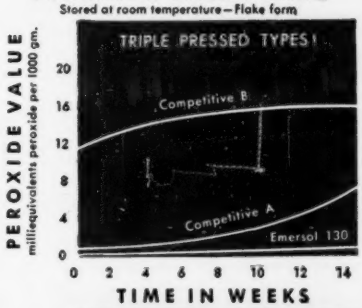

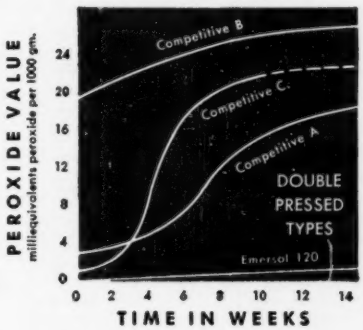

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ABOUT THE COVER

Emery's new pilot plant, pictured in part on the cover, has been a key factor in the development program of new processes and products for the lubricating grease industry.

The versatility of this equipment, which includes distillation columns, autoclaves, a small scale Emersol plant, etc., is illustrated by these important Emery developments:

1) Colgate-Emery high pressure splitting for animal and vegetable fatty acids of high purity.

2) Emersol process for solvent separation for high purity oleic and stearic acids, including Emersol 233LL Elaine; Emersol 240 Vegetable Elaine, an oleic acid of all vegetable origin; and Emersol 132 Lily Stearic Acid, a high quality crystalline stearic acid.

3) Commercial chromic acid oxidation of oleic acid to form azelaic and pelargonic acids for synthetic diester greases.

4) High-pressure dimerization of highly polyunsaturated acids to produce Emery 955 Dimer Acid (dilinoleic acid).

Of recent interest are the new, expanded production facilities, now under construction, for producing azelaic and pelargonic acids, the esters of which are used in synthetic greases and synthetic lubricants. This new process, a "protege" of the pilot plant, produces azelaic and pelargonic acid by utilizing ozone as the oxidant. This revolutionary process represents the first large-scale use of ozone in the chemical process industry.

President's page

by George E. Merkle, President, N.L.G.I.

ECONOMICS

A definition of economics is "the science that treats of the production and distribution of wealth." Economics is also called political economy.

It is doubtful if more than a very few per cent of the people in this country ever seriously consider or understand how important this subject is to every individual. Too often we are inclined to think that the subject is over our heads and that somebody else should worry about it.

Many scientific developments and inventions have greatly contributed to the improved living conditions we enjoy today. The multitude of new products such as synthetic textiles, for example, have raised our standard of living. Strides have been made in agriculture, increasing productivity of farms; and many scientific applications have resulted in improved quality and flavor of fruits and vegetables.

In the steel industry we know of the improved quality of steel products as regards rust resistance of stainless steel, increased strength of the metal for new and severe applications. This same story can be repeated for many industries whether it be copper or glass or plastics. They are too numerous to consider here.

But, with all these advantages that we enjoy today, we cannot escape the fact that economics is an important part of our life. What good are all these improvements to us if bad economics are employed and goods cannot be purchased or even produced?

If one is privileged to read the various releases from several large industries treating of this problem, he would find that there are some who know and try to practice the science of economics. They know that what is good for the public helps them.

In recent years there have been large groups who cannot be totally ignorant of this subject, but have made every effort to ignore it. These people blindly believe that they can look out for themselves and the rest of the people can take the load.

It is high time that we realize that the boss is the customer. When he refuses to pay the price we cannot sell and all in that industry suffer loss of employment. If the price can be reduced the sale may be made, but if this does not leave a fair margin for the marketer. He cannot continue selling and again employment is reduced.

Those who ignore the laws of economics should wake up and realize that they not only are imposing a great burden on the rest of the nation but are threatening their own security. Our security, economically, depends upon a healthy business and it is everyone's concern that good business and therefore good employment be maintained. They go hand-in-hand.

Everyone should study and fairly appraise the results of present high taxes on industry and the individual. If he does he is likely to take a more active interest in corrective measures.

In the beginning I said that economics and political economy were the same. This is true in the dictionary but our present "political" economy has ignored economics based on what we hear and read and the effects on industrial and individual security from which we are suffering.

Let's practice sound economics and we will enjoy more economies and more security.

PHTHALOCYANINE LUBRICATING GREASES

VINCENT G. FITZSIMMONS
ROBERT L. MERKER
CURTIS R. SINGLETERRY

NAVAL RESEARCH LABORATORY, WASHINGTON, D. C.

THE increased operating temperatures possible for electric motors insulated with silicone resins has created a need for a grease which will lubricate ball bearings at 200° C. or above. The soap phase of ordinary or of silicone greases deteriorates within a very short time at this temperature.

Phthalocyanine pigments have been shown to form greases from petroleum oils, silicones, aliphatic diesters, polyalkylene glycol ethers, and fluorocarbons. These greases contain 80% or more of liquid by volume and maintain their structure to above 300° C. They are water resistant (shear stable, and less susceptible to oxidation than corresponding soap greases. Phthalocyanine pigment is not abrasive. Phthalocyanine-gelled silicone greases have lubricated ball bearings for 10,000 hours at 80° C. and for as long as 900 hours at 220° C. Special alloy steels are necessary in bearings operating at 200° C. or above.

The development of greases useful at 200° C. permits the redesign of electric motors with large economies in space, weight, and critical materials.

Recent trends in the design of equipment for both military and civilian use call for greases useful at temperatures in the range between 150° and 250° C. Soap-gelled silicone greases have been found useful to 150° C. but above this temperature oxidation and phase changes in the soap have limited the use of such lubricants. The soaps commonly used in greases also act as accelerators of the oxidation of the liquid phase present. Other work in this laboratory has been concerned with the study of oxidation inhibitors capable of effectively protecting lubricating oils and soaps at temperatures above 150° C. (*21*), with the development of soap-gelled greases from lubricating fluids such as the silicones, which are less sensitive to oxidation at high temperature (*20*), and with the study of the factors controlling the effectiveness of grease lubrication at high temperatures (*6*).

The present communication describes the investigation of a nonsoap gelling agent for lubricating greases, which has a much greater resistance than soaps to thermal decomposition and to oxidation at temperatures above 150° C. Nonsoap greases have been reported that were gelled with carbon black, ultrafine silica gel (*16*), and with specially treated bentonite clay (*12*); oils have been thickened with graphite, talc, and with asbestos fiber (*17*).

A silicone fluid thickened with carbon black gives a chemically stable system but such greases have not been found to be reliable lubricants for ball bearings. The silica and bentonite greases thus far available resist high temperatures well for short periods, but lose their greaselike character on prolonged heating at 150° C. or above.

The high melting point, chemical inertness, and high thermal stability of the phthalocyanine pigments, together with the exceedingly fine state of division in which they were available, made them seem an interesting type of gelling agent for the formation of greases. Preliminary experiments indicated that they did have a gelling effect on oils which was comparable on a volume basis with that of the soaps, and that the resulting mixtures showed the physical properties and the lubricating abilities of conventional greases. An investigation of the possibilities and limitations of the phthalocyanine pigments as gelling agents for the preparation of lubricating greases was therefore undertaken.

Phthalocyanine Pigments and Their Properties

Phthalocyanine pigments are all blue or green in color and are used widely in printing inks, artists' colors, paints, rubber, etc. They are notable for their high degree of stability to heat, oxidation, and other extreme physical and chemical conditions. The remarkable heat stability of this class of compounds is illustrated by their sublimation in vacuum without decomposition at temperatures around 500° C. The

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pigments show little or no oxidative destruction in the atmosphere at temperatures below 350° C. (*9*). The extreme stability of the phthalocyanines to heat, oxidation, and chemical regents can be attributed to the unusual structure of the phthalocyanine molecule. Figure 1 shows the structure assigned to copper phthalocyanine, one of the most stable and

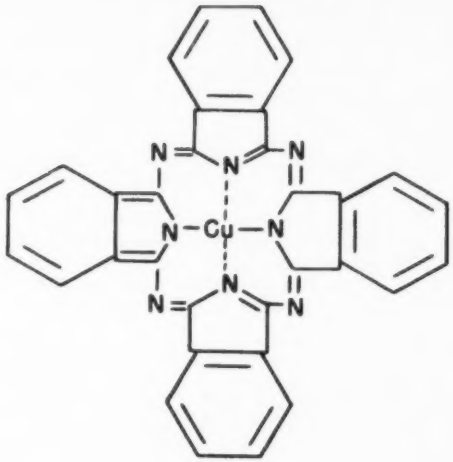

FIGURE 1

Structure of
Copper Phthalocyanine.

widely used pigments of this class (*3*). This is a fully conjugated and very symmetrical ring system in which a high degree of resonance is possible. Remarkable evidence for the strong nitrogen to copper bonds is the fact that this compound is used as a pigment in rubber in spite of the fact that even slight traces of ionizable copper catalytically accelerate the oxidation of rubber (*9*). Numerous other phthalocyanine compounds have been prepared (*3*), all having chemical and physical properties somewhat similar to those of copper phthalocyanine.

Copper phthalocyanine is insoluble in water and in most organic solvents even at elevated temperatures. It is soluble in concentrated sulfuric, chlorosulfonic, and ethylsulfuric acids and can be reprecipitated in a microcrystalline state from solution in these acids upon dilution in a large volume of water.

Samples of copper phthalocyanine from commercial pigment production have particle sizes in the range between 0.01 and 0.1 micron in order to obtain optimum tinctorial strength. Many phthalocyanine pigments, especially in the presence of aromatic solvents, have been observed to show a pronounced increase in average particle size after incorporation into inks or paints. Hamm and Van Norman (*14*) have reported copper phthalocyanine to be at least dimorphic and demonstrated the transition from the metastable to the stable form through vacuum distillation at 127° C. and 0.1 micron pressure. The transformation of phthalocyanine pigments to large crystals in an aromatic solvent (see Figure 4) appears to be a phase change of this sort, as distinguished from the coarsening of ultrafine precipitates by the familiar digestion process of analytical chemistry.

The commercial pigments examined as grease-forming agents during this investigation exhibited the growth of large crystals to extents depending upon the particular pigment sample and upon the type of lubricating fluid present. Crystal growth was most pronounced in petroleum, polypropylene glycol ethers, and aliphatic diester fluids, less rapid in methyl-phenyl polysiloxanes, and almost negligible in dimethyl polysiloxanes. A given sample of copper phthalocyanine exhibited approximately the same final crystal development in any of the crystal-growing solvents, but different samples gave widely differing amounts, or even showed no development whatever of crystals visible in the optical microscope after several weeks at temperatures as high as 225° C. These observations suggested that the commercial pigments were variable mixtures of a metastable and a stable form. For convenience of reference the metastable form may be designated as the alpha and the stable form as the beta modification. The proportion of the metastable alpha form present can vary with the preparative history of the pigment and appears to approach zero in the best samples studied, indicating that it is

TABLE I

GELLING EFFECT OF COPPER PHTHALOCYANINE WITH VARIOUS LUBRICATING FLUIDS[1]

Identity	Fluid	Viscosity at 100° F., Centistokes	Fluid Density at 25° C.	Copper Phthalocyanine Wt. %	Copper Phthalocyanine Volume %[2]	Worked Micropenetration (*15*)	Bleeding 50 Hr. at 150° C. (*6*)
CPC-S500-8	Methyl polysiloxane	44.4	0.96	22	14.8	245	6.0
CPC-S550-4	Methyl phenyl polysiloxane	95.4	1.070	22	15.9	280	6.0
CPC-S710-11	Methyl phenyl polysiloxane	117.0	1.092	22	15.7	222	5.2
CPC-F-15	Polytrifluoromonochloroethylene	86.9	1.953	16.6	19.3	72	1.0 (100° C.)
CPC-P-14	Polypropylene glycol ether	286.6	0.994	24	18.3	205	5.0
CPC-P-12	Petroleum oil NS 1120	369.0	0.887	22	14.8	282	7.0
CPC-D-17	Di-(2-ethylhexyl)sebacate	12.6	0.913	26	16.6	224	7.3
CPC-D-18	Di-tetradecyl sebacate	44.0	0.884	24	15.2	354	8.8

[1] All greases shown in this table contained 1% dilauryl selenide as an oxidation inhibitor.
[2] Based on real densities.

technically feasible to prepare the pigment in substantially the pure beta form if necessary. Copper chlorophthalocyanines, and copper phthalocyanines carrying a small proportion of tin (*4*) show little or no tendency to develop large crystals of the type described. All of the greases reported here were formulated from phthalocyanine pigments which showed a negligible tendency to crystal growth.

Formation of Greases

A wide range of lubricant fluids have been gelled to greases with copper phthalocyanine. Table I records pertinent data for a series of such greases compounded (with two exceptions) to give comparable consistencies. In spite of the wide range of polarity and of viscosity represented by the fluids, the greases of comparable micropenetrations required 16 volume % of copper phthalocyanine with an average deviation of only 1%. The high volume per cent of gelling agent in the chloro-fluorocarbon polymer is reflected in a much stiffer consistency. Most soap-gelled greases carry between 10 and 23 volume % of soap, so the proportional volume of oil in the phthalocyanine greases is comparable with that in conventional greases.

In spite of the rather uniform volume-effectiveness of copper phthalocyanine in various fluids, there are very real differences in the ease with which the pigment can be dispersed. Dispersion is more difficult in the presence of silicones, particularly the polymethyl type, and in fluorocarbons. Pigment purity must also be more stringently controlled to obtain satisfactory greases from such fluids. Amphipathic polar substances, such as alcohols, acids, etc., may increase the ease of dispersion of a given pigment, but as shown in Table II they also reduce the gelling efficiency. Such decreases in gelling efficiency are readily compensated by the use of 1 or 2% more pigment.

The greases listed in Tables I and II were all formulated from copper phthalocyanine, but greases were prepared from copper-tin phthalocyanine, from copper monochloro- and polychlorophthalocyanine and from metal-free phthalocyanine, as well as from calcium and iron phthalocyanine. Given a suitable particle size, it appears that greases might be formulated from a very wide range of metal phthalocyanines. The work here reported was largely restricted to copper phthalocyanine because of its superior chemical stability and its commercial availability.

TABLE II

EFFECT OF POLAR ADDITIVES ON COPPER PHTHALOCYANINE GREASES CONTAINING A METHYLPHENYL SILOXANE

Grease	Antioxidant	Pigment Wt. %	Worked Micro-penetration	Wt. % Bleeding 50 Hr. at 150° C (*6*)
CPC-S550-2	None	22	175	2.5
CPC-S550-3	1% isopropoxy-diphenylamine (*19*)	22	211	4.0
CPC-S550-4	1% dilauryl selenide	22	280	6.0

Pure phthalocyanine pigments are difficultly wet by water, and transfer readily by the flushing technique from water dispersions to oils. This characteristic leads to water-resistant greases. The high density of copper phthalocyanine, 1.62, makes it possible to formulate lubricants from the methyl phenyl polysiloxanes or from halocarbons that are not only water resistant, but also nonfloating in sea water. When copper polychlorophthalocyanine was employed as the gelling agent, nonfloating greases were obtained from every type of lubricating fluid studied.

Phthalocyanine pigments may be dispersed in lubricating fluids to give grease structures by passing the mixture through a conventional colloid mill, by intensive high speed mixing under conditions which return all parts of the batch repeatedly to the mixing zone, by preliminary dispersion in a volatile aromatic solvent which is removed after addition of the lubricating oil, or by conventional ink or paint milling procedures. The essential effect is the breaking down to ultimate particles of aggregates formed during drying of the filter presscake. A standard midget paint mill, 2½x3½ inches, was found convenient for research and small scale production of phthalocyanine greases. The preparative procedure is conveniently described in five steps, as follows:

1. The dry pigment is preheated to 225° C. to remove water and possible traces of thermally unstable impurities which might otherwise evolve gases during service, thus causing a spongy structure, bleeding, and poor adhesion to metal surfaces. The pigment temperature should not be allowed to exceed 250° C.; at temperatures near 350° C. the very high specific surface of the pigment may allow a self-propagating oxidation to set in. (This phenomenon has never been observed, even at 400° C., when the pigment was dispersed in an oil.) The pigment should be cooled before combination with the lubricating liquid.

2. The pigment is slurried with the appropriate amount of lubricant fluid. A significant amount of dispersion of pigment aggregate can be accomplished at this stage by intensive stirring at 5000 r. p. m., preferably with a multiple propeller assembly. Stirring becomes ineffective when the slurry has bodied up to a plastic mass that does not recirculate to the stirring zone.

3. The thickened slurry is cycled through the paint mill until it loses its granular appearance to become smooth and

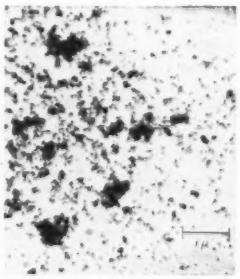

FIGURE 2. Electron Micrograph of Copper Phthalocyanine from Undried Press Cake.

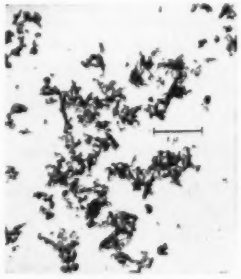

FIGURE 3. Electron Micrograph of Copper Phthalocyanine Particles in a Methyl Phenyl Polysiloxane Grease. (Prepared from the pigment shown in Figure 2)

shiny, and has ceased to flow along a 45° slope under its own weight in layers ½ inch or less in thickness.

4. The milled product is then heated for 2 hours at 225° C., or at the maximum (lower) temperature the fluid phase will tolerate without excessive deterioration. This heating greatly assists in the dispersion of the pigment into its ultimate particles, and changes the soft semimilled product into a stiff plastic mass. The same final dispersion could be accomplished by continued milling in step 3 but the procedure would be wasteful of machine and operator time.

5. The heat-bodied grease is finished by remilling to a softer consistency; it still retains, however, a substantial portion of the body developed during heating. Additional heating and milling cycles produce little further change in the physical character of the grease.

For the preparation of larger quantities of grease it has been found advantageous to replace steps 2, 3 and 4 of the above process by a cycling of the original slurry in a closed system through a pressure relief valve set to open at 500 to 700 pounds per square inch. Enough heat is generated so that step 4 can be omitted but some improvement in texture results from a final pass through a 3-roll ink or paint mill.

Electron micrographs of the pigment before incorporation in a grease, and of the same material after the final heating and milling, are shown in Figures 2 and 3, respectively. It appears that the heat treatment results not only in more effective dispersion of the ultimate pigment particles but in some perfecting and elongation of crystal forms. All of the particles remain below the limit of optical resolution, however, and this process should not be confused with the development of macrocrystals several microns in length which is noted with unsuitable pigments containing considerable amounts of the unstable alpha phase, as illustrated in Figure 4.

The characteristics of the pigment used in the preparation of copper phthalocyanine greases have been found to be critically important. Commercial grades designed for use in paints or printing inks frequently contain resins to assist in dispersion, and may contain inorganic materials of an abrasive nature. Copper phthalocyanine for grease formulation should be the pure compound prepared for this use in pigment fineness, and should contain less than 0.5% of material volatile at 225° C. or soluble in acetone. It should be soft milling, and a grease formulated with it from di-(2-ethylhexyl) sebacate should exhibit no crystals resolvable in an optical microscope either before or after heating at 150° C. for 4 hours. (The examination should be made with convergent incident light.) The ultimate particle size is critically important; the gross size of the aggregates is not critical if they will pass a 20-mesh screen and are soft milling. Extremely fine powders lead to contamination of the clothing and working area by airborne pigment.

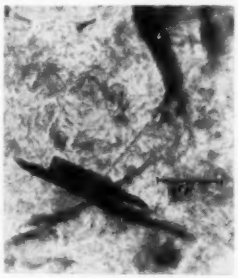

FIGURE 4. Electron Micrograph of Large Crystals of Copper Phthalocyanine. (Developed by an unsuitable pigment in an aromatic solvent)

Behavior at High Temperature

Copper phthalocyanine greases were found to be extremely shear stable in the Hain microworker (*13*) and in the power driven worker-consistometer (*24*). There was also no evidence of shear breakdown noted in 10,000-r. p. m. bearing tests. However, these greases, notably those containing a silicone fluid, exhibited a novel type of thixotropic behavior as a function of temperature. Instead of becoming softer with rising temperature from the decrease in viscosity and the thermal expansion of the liquid phase, the grease was observed to maintain its penetration almost unchanged to 150° C. and then to develop a stiffer consistency as the temperature rose beyond this point to 225° C. (curve 1 of Figure 5). The thixotropic nature of the phenomenon was made clearer when greases heated to the various temperatures were cooled to 25° C. before measurement of their micropenetration, thus restoring the original viscosity of the fluid phase and the original specific volume (curve 2 of Figure 5). Reference to point △ of Figure 5, which represents the worked penetration of the grease as 25° C., indicates that there is a small but definite thixotropic setup of the grease even at room temperature. All of the samples which had been heated to higher temperatures returned to their original worked penetration of 175 after 10 passes in the Hain microworker. This thixotropic behavior is fully reversible and should not be confused with the initial irreversible thickening produced by heating the partially dispersed grease during manufacture. The thixotropic behavior of diester of petroleum greases gelled with copper phthalocyanine is less marked than that of the silicones.

The bleeding of oils from copper phthalocyanine greases is similar in type to that observed with good soap greases. Farrington and Humphries (*11*) have studied the loss of oil from several soap-type greases during pressure filtration and found that, except during the very early part of the filtration, their results could be expressed by the equation $t/S = a + bt$, where S is the per cent of liquid separated at

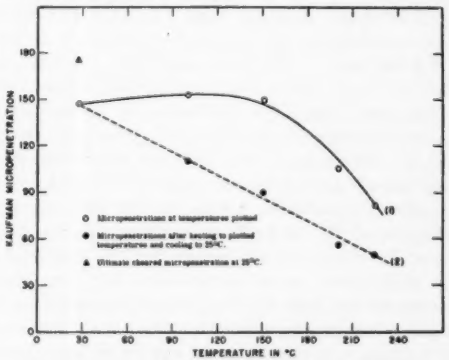

FIGURE 5. Thixotropic Behavior of Phthalocyanine Grease CPC-S550-2.

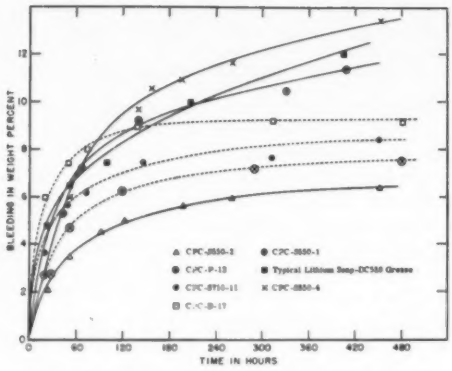

FIGURE 6. Bleeding Characteristics of Phthalocyanine Greases at 150° C.

time t, and a and b are constants. The data for a system obeying this equation gives a straight line when t/S is plotted as a function of t. The reciprocal, $1/a$, of the intercept of this line with the axis of time gives the initial bleeding rate, dS/dt, and the reciprocal, $1/b$, of the slope is the measure of the ultimate total bleeding predicted by the equation.

Comparable open-cone bleeding data for various phthalocyanine greases are shown in Figure 6. The bleeding of these greases was found to conform to the Farrington and Humphries equation. The solid lines of Figure 6 identify the data for greases from one methyl phenyl polysilicone fluid gelled with lithium stearate and with three copper phthalocyanine formulations, respectively. Figure 7 presents the Farrington and Humphries plots for these same greases, the characteristic bleeding constants of which are given in Table III. CPC-S550-1 and CPC-S550-4, which contained 19 and 22% of pigment, respectively, but which had somewhat comparable micropenetrations, show roughly similar initial bleeding rates and ultimate bleedings; they match rather closely the behavior of the soap-silicone grease Mil-G-15719 (Ships) listed in Table III, while CPC-S550-2, which contained the same pigment concentration as CPC-S550-4 but had a much lower penetration, also has lower initial bleeding as well as lower ultimate fluid release. It will be seen from Table I that the bleeding of greases showing equivalent micropenetrations is surprisingly uniform, even for fluids of widely different viscosities. The soap-silicone grease which showed bleeding behavior closely comparable with the two softer phthalocyanine greases had the very low micropenetration of 50. This difference is typical, and in consequence the phthalocyanine greases can be formulated to have much softer worked consistencies than soap greases intended for the same service. This in turn favors smaller breakaway and running torques at extreme low temperatures. The variation in bleeding behavior with temperature is shown in Figure 8, which also carries data on the evaporation losses that occurred during the same intervals in the open-cone test of bleeding. It can be seen that after 200 hours at 200° C. the evaporation was great enough to volatilize the methyl phenyl polysilicone fluid as rapidly as it was released. The geometry of the system is, of course, not equivalent to that of grease in a bearing, but the same effect must operate there also, so that at sufficiently high temperatures even the life of a grease formulated from a hundred centistoke silicone will be limited by evaporation effects.

The oxidation characteristics (in the Norma Hoffman bomb at 150° C.) of copper Phthalocyanine greases formulated from various fluids are presented graphically in Figure 9. The relative sensitivity to oxidation of soap and of pthalocyanine greases formulated from identical or closely equivalent fluids is shown in Figure 10 A, B, C, and D. It will be seen that the copper phthalocyanine greases are consistently less sensitive to oxidation than their soap-thickened analogs. This increased stability arises not only from the absence of an easily oxidized soap phase but because copper phthalocyanine, unlike the soaps, is not an oxidation catalyst. This property shou'd give improved shelf life to equipment lubricated with copper phthalocyanine greases and lengthened service life in situations where oxidation of the lubricant is a controlling factor. The copper phthalocyanine greases were also noteworthy for preserving their consistency and texture almost unchanged during 300-hour bomb tests at 150° C., whereas soap greases always gave abundant evidence of oil separation, caking, or carbonization.

Performance in Service-Simulating Tests

In order to compare some of the high temperature characteristics of the copper phthalocyanine greases with those of several commercial high temperature greases, a special test apparatus was devised. It consisted of a smooth piece of cold-rolled steel, 15x5x0.95 cm., to which was secured a 250-watt strip heater. The temperature of the metal was measured by means of a thermocouple. The grease specimens were put on the panel at room temperature in 1.2x6.0 cm.

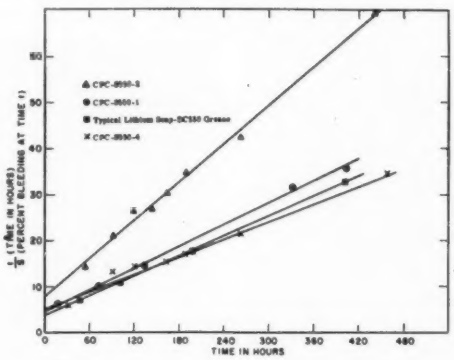

FIGURE 7. Application of the Farrington and Humphries Equation to Bleeding of Phthalocyanine Greases.

TABLE III

BLEEDING CONSTANTS FOR SOAP-GELLED AND PHTHALOCYANINE-GELLED GREASES

Grease	Initial Bleeding Rate, % per Hour	Ultimate Bleeding %	Worked Micro-penetration at 25° C.
CPC-S550-2	0.125	7.3	175
CPC-S550-1	0.218	12.7	347
CPC-S550-4	0.185	14.8	280
Soap-methyl phenyl polysiloxane [Mil-G-15719(Ships)]	0.250	12.3	50

strips 0.0065 cm. thick. The plate was mounted in a vertical position; heat input was adjusted to produce a rise of 2° C. per minute.

The results obtained from this test are tabulated in Table IV, in which five commercial high temperature greases are compared with two types of phthalocyanine greases. Undesirable structural changes occurred at or below 230° C. in all the commercial greases tested. The two phthalocyanine greases examined retained their grease structure and stability even at temperatures as high as 300° C. It appears that volatilization of the base fluid is one of the most serious factors limiting the use of copper phthalocyanine greases at such elevated temperatures. It is probable, however, that phthalocyanine silicone greases could be used in applications where temperatures in excess of 300° C. are encountered for short intervals of time, as in some types of expendable equipment.

The nonabrasive character of copper phthalocyanine is shown by the results of tests in the Navy Gear Wear Tester (*23*) that appear in Table V, in which two phthalocyanine greases are compared with soap thickened greases prepared from the same fluids. These results, on the other hand, do not suggest that copper phthalocyanine has important load-carrying properties not found in soaps.

Performance in Ball Bearings

At normal operating temperature, 80° C., grease CPC-S550-9 lubricated an SAE 310 bearing of an 1800-r.p.m. motor-generator test set for 10,000 hours without any symptoms of failure; the run was discontinued only because of the conclusion of the test program of which it was a part. This performance shows that the copper phthalocyanine gelling agent does not possess inherent deficiencies that will limit its performance in normally operated ball bearings.

At low temperatures the point of interest is the relative torque requirement of phthalocyanine and soap-type greases formulated from identical lubricating fluids. In this case the controlling factor is the viscosity-temperature relation for the fluid. The advantages for the phthalocyanines appearing in Table VI are probably a result of the softer initial consistency in which it is desirable to formulate such greases. No data are available on a soap-silicone grease directly comparable with CPC-S200, which contains a 20-centistoke methyl polysiloxane fluid.

In bearings operating at 150° C. the CPC-S550 greases have been found to be closely comparable with the best commercial soap-silicone greases — specification Mil-G-15719 (Ships) — as would be expected if the limiting factor for life at this temperature is the lubricating ability of the fluid phase. Tests have been made at 150° C. in motor-generator sets, in the NRL Visible Tester (*6*), and in the Navy High Speed Tester (*1*).

At 200° C. or above, where the greater chemical stability of the phthalocyanine thickener would promise advantages, performance has until recently been obscured by metallurgical changes in test bearings made of the usual bearing steel, even though the bearings had been heat treated for operation at 200° C. During test runs at 220° C. the hardness of the races was noted to drop from 60 Rockwell C to as low as 41 Rockwell C. The recent availability for research use of No. 204 bearings fabricated from high speed tool steel has made effective testing of grease performance in this temperature range possible.

Observations were made on the Texas Co. high speed spindle tester (*18*) modified by the addition of heat exchange surfaces to maintain the temperature of the inner race closer to that of the outer at elevated temperatures. The operating speed was 3600 r.p.m. At 220° C. the soap-silicone grease — Mil-G-15719 (Ships) — found most suitable for use at this temperature gave indications of rapid oxidation and thermal cracking during the first 24 hours of operation. The bearing became noisy after running 50 hours, at which time examination showed that the races were beginning to be starved for lubricant; however, 150 hours of noisy operation elapsed before the bearing failed with the fracture of the ball separator component. A similar test in which the tool steel bearing was lubricated with a grease formulated from copper

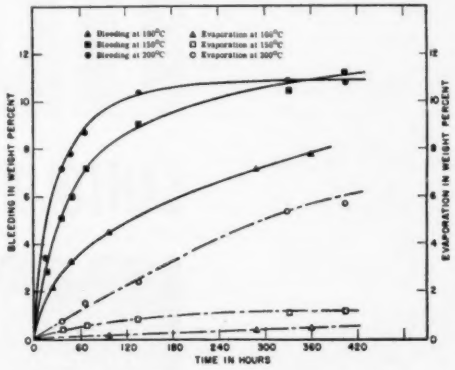

FIGURE 8. Effect of Temperature on Bleeding and Evaporation of Phthalocyanine Grease CPC-S550-1.

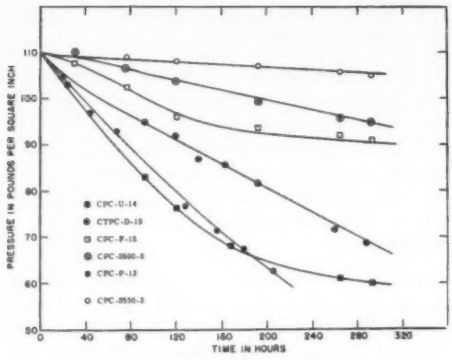

FIGURE 9. Oxidation Characteristics of Phthalocyanine Greases in Norma Hoffmann Bombs at 150° C.

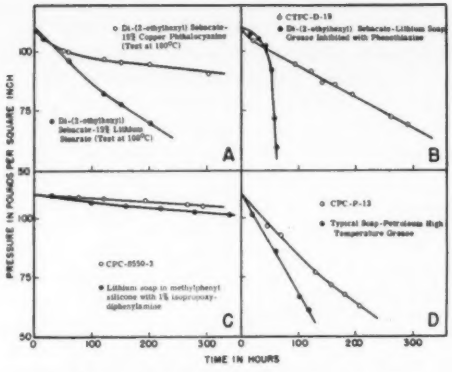

FIGURE 10. Relative Resistance of Comparable Phthalocyanine and Soap Greases to Oxidation in the Norma Hoffmann Bomb at 150° C.

phthalocyanine and a methyl phenyl polysilexane similar to that present in the soap-silicone grease operated quietly for 912 hours before excessive noise developed and the run was discontinued without failure of the bearing. The result illustrates both the new range of operating temperature made available by phthalocyanine greases and the importance of special alloy bearings for service at such temperatures. In tests conducted at this laboratory bearings of conventional steel lubricated with a similar grease have never given a life as high as 200 hours at 200° C. with the equip-

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TABLE IV

BEHAVIOR OF SEVERAL HIGH TEMPERATURE GREASES IN CONTACT WITH A HOT STEEL SURFACE

Grease Identification	150° C.	175° C.	200° C.	Above 200° C.
Commercial grease I, sodium soap in petroleum oil	Spongy	Less adherent, profuse bleeding, and volatilization	Grease melted and slipped off the panel	
Commercial grease II, carbon black in methyl phenyl polysiloxane	Decreased adherence	Frothy and granular, profuse bleeding, and much less adherent		
Commercial grease III, lithium soap in methyl phenyl polysiloxane	Profuse bleeding, less adherent	No change	Grease became a translucent gel	Melted and slipped from the panel at 230° C.
Commercial grease IV, strontium soap in petroleum oil	Grease became a translucent gel	Oil Volatilizes	Grease became a rigid gel	
CPC-P-13	No change	Oil Volatilizes	No change	Soft and adherent at 250° C., rapid volatilization
CPC-S550-4	No change	Thickens slightly	No change	Soft and adherent at 300° C., moderate volatilization

ment described.

At temperatures above 150° C. soap-gelled greases previously available have often performed poorly because of excessive bleeding or of melting or phase changes in the soap. These are problems which might be solved by new types of soaps and proper formulation, but at 220° C. the soap greases fail because of their inherent chemical instability. On the other hand copper phthalocyanine is at this temperature well over 100° C. below the temperature at which its atmospheric oxidation becomes an important factor, and at least 300° C. below that at which thermal cracking occurs in a nonoxidizing atmosphere.

The increased thixotropic setup of the methyl phenyl polysiloxane greases at higher temperatures was apparent also during bearing tests. Substantial amounts of the grease adhered to the ball retainers of bearings operating at 150° to 220° C. at speeds of 1800, 3600, and 10,000 r.p.m.; the small amount of grease remaining in the races was softer and flowed under the shearing action of the balls. The importance of the thixotropic behavior was demonstrated when the test bearing in the NRL Visible Tester (6) was stopped, cooled to room temperature, and restarted. It is on this restart that conventional soap greases fail to provide enough lubrication to the bearing because of previous bleeding and because of the hardening of the cooled grease residue, whereas the phthalocyanine greases were observed to become extremely soft and mobile during this restarting cycle. The latter flowed in a moderately heavy layer into the ball track until the bearing approached 150° C., when the excess grease was deposited on the retainers and outer edges of the races. This behavior was repeated as often as the bearing was subject to the stopping, cooling, and restarting cycle.

Discussion

The need for a grease lubricant capable of dependable performance at temperatures above 150° C. is by no means restricted to military activities. There have been many industrial inquiries about the possibility of securing such a lubricant. They have come from responsible technical personnel in widely different industries, including manufacturers of electronic devices, electric motors, optical instruments, chemical processing equipment, ball bearings, and heavy chemicals. It is apparent that the pressure of problems calling for a high temperature lubrication is already acute. In addition, the obvious economics in equipment design and

TABLE V

PERFORMANCE OF PHTHALOCYANINE GREASES IN THE NAVY GEAR WEAR TEST

Grease	Weight-Loss of Test Specimen in Mg. per Kilocycle	
	5-lb. load	10-lb. load
14-G-8, soap and di(2-ethylhexyl) sebacate	1.0	2.3
CPC-D-17, di(2-ethylhexyl)sebacate fluid	1.0	4.1
Mil-G-15719 (Ships), soap-silicone grease	36.0	...
CPC-S550, methyl phenyl polysiloxane fluid	20.0	...

TABLE VI

FUNCTIONAL TORQUE TEST OF PHTHALOCYANINE GREASES AT —65° F.

	Torque, in Inch Ounces × 10^{-4}			
	R-3 bearing, Co. A		R-3 bearing, Co. B	
Grease	Starting	1.2 r.p.m.	Starting	1.2 r.p.m.
14-G-8, soap and di(2-ethylhexyl) sebacate	560	90	320	140
CPC-D-17, di(2-ethylhexyl) sebacate	190	46	110	25
CPC-S200, 20-csk. methyl polysiloxane fluid	95	38	54	28

in operating procedures which reliable lubrication at temperatures of 150° C. or above makes possible are so great that the higher cost of such a lubricant is negligible in comparison. As an example, such a grease for electric motors, in combination with silicone insulated windings and heat-stable ball bearings, permits design for a much higher operating temperature than was heretofore tolerable. In consequence the volume and weight of such a motor may be reduced by as important a factor as one half or two thirds.

The potentialities of phthalocyanine greases have not been fully explored. The pigments are chemically stable and retain their grease-forming characteristic at temperatures so high that no lubricating fluid at present available for gelling with them can be expected to show a useful life of more than a few hours at the upper limit of usefulness of the pigment. The methyl- and the methyl phenyl polysiloxanes deteriorate or polymerize seriously at temperatures above approximately 200° and 250° C., respectively (*2, 22*). A lubricating fluid possessing a higher order of chemical and thermal stability, a very low vapor pressure, and an unusually wide liquid range is required to utilize the possibilities of the phthalocyanine greases at 300° C. The usefulness of the silicone lubricating fluids at high temperatures appears at present to be limited also by their shortcomings as boundary lubricants (*5-8*). It is believed that research will eventually eliminate this deficiency and lead to major improvements in the performance of all silicone-base lubricants. Since pure phthalocyanines do not contribute boundary lubricants of the type sometimes introduced into greases with the soap thickener, the performance of phthalocyanine greases containing other fluids than the silicones may be expected to show improvement on the addition suitable wear-preventive compounds.

It is possible also that copper phthalocyanine, the material which has been most carefully studied thus far, does not provide the maximum resistance to oxidation or other chemical attack obtainable with the phthalocyanine structure. Copper polychlorophthalocyanine, for example, shows higher resistance than copper phthalocyanine to oxidation in pigment applications or on heating the dry powder to temperatures of 350° C. or above in air. It is an effective gelling agent in oils and may have advantages in some situations.

In addition to the immediate practical applications described, the formation of effective lubricating greases from phthalocyanine pigments — particularly when taken with other current developments in nonsoap-type greases—throws light from a new angle on the mechanism of grease lubrication. The high purity and the chemical stability of copper phthalocyanine, the exact information available on its chemical structure and crystallography, and its behavior as a thixotropic gelling agent also provide an admirable model for use in basic studies of colloidal phenomena which will be significant in a wider field than the production of lubricating greases.

Summary

Phthalocyanine pigments are effective gelling agents for the formation of greases from a wide variety of petroleum and synthetic lubricating fluids. They give products similar in texture, bleeding rate, and lubricating performance to conventional soap greases.

Phthalocyanine-gelled greases have several distinct advantages. They retain a useful grease structure for extended intervals at temperatures above 150° C. They have lower sensitivity to oxidation at all temperatures. This gives longer service life at high temperatures and longer storage life for lubricated components at normal temperatures. They are inherently water repellent. They have a tendency to stiffen instead of soften at elevated temperatures. In conjunction with their low bleeding rates, this resistance to softening permits formulation with softer consistencies, which in turn results in smaller torque requirements at very low temperatures than are found for soap greases containing the same lubricant fluid.

The behavior of the phthalocyanine greases in laboratory and in functional tests indicates that the high temperature limit for the successful operation of grease-lubricated ball bearings is now set by the chemical and thermal stability of the oils available for grease formulation and by the metallurgy of the bearings themselves.

Acknowledgment

The authors acknowledge gratefully the assistance of Lorraine Arkin and John Larson of this laboratory in the preparation and functional testing of the early phthalocyanine greases. They also thank the Jackson Research Laboratory of E. I. du Pont de Nemours & Co., for their valuable cooperation in specially preparing numerous samples of phthalocyanine pigments, and for the electron micrographs of typical preparations. Test data concerning the phthalocyanine greases prepared at this laboratory have been made through the courtesy of the Naval Ordnance Plant at Indianapolis, the Naval Engineering and Experiment Station at Annapolis, and the lubrication research group of the Thompson Laboratory of the General Electric Co.

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Battenfeld Grease & Oil Corp.

NOT so many years ago industrial plant lubrication was pretty much of a "hit and miss" proposition. Lubricating oils and greases were selected and requisitioned by plant personnel whose prime knowledge was mechanical equipment and who, at best, had a sketchy background in the field of lubrication.

This factor accounted for tremendously high inventories of lubricating oils and greases in the industrial plant since each foreman or division head used the lubricants which he deemed best for the application to his machinery. Chaos reigned and the duplication of lubricants for identically the same purpose was rampant. Equipment breakdown due to mis-application of lubricants was the order of the day. Contributing to this factor was the fact that new personnel were used as "oilers." Their knowledge of equipment was necessarily limited and their instructions usually amounted to "grease the machinery."

Forward thinking management of certain industrial organizations began to realize the tremendous expense of this type of operation and began to add to their staff personnel whose prime responsibility was lubrication. From this beginning sprang the still young but vigorous profession of lubrication engineering. Due to the fact that the profession of industrial lubrication engineering is young, there exists widely divergent opinions as to the functions of this profession in the minds of the management of a considerable number of industrial organizations. With the hope of clarifying the thinking of some of these people, the following suggested responsibilities are outlined.

In order for the plant lubrication engineer to perform at maximum efficiency and be of greatest value to his company, he must (1) be responsible for the selection of proper lubricants for use in every application in his plant. This responsibility must include testing of lubricants to determine the most efficient lubricant for any given application. It must involve consideration of the use of multi-purpose lubricants, balancing the advantages in these lubricants against the use of special products for each given application.

He must (2) provide the purchasing department of his company with a list of approved lubricants. His selection of lubricants must be broad enough to provide the purchasing department with a minimum of three sources of supply for each lubricant involved in order to permit that department sufficient flexibility in their activities. He must be well aware of the importance of this feature in his responsibility and must select his lubricants with a wide enough base to permit this sort of freedom to the purchasing department.

He must (3) be responsible for the selection of proper methods of lubricant application. Of equal importance with proper lubricants in the satisfactory lubrication of industrial equipment is the methods and frequency of application. Certain industrial lubricants, despite high initial product costs can actually reduce total lubricating costs if correctly applied. Unless he has complete control of method and frequency of application, complete advantage cannot be taken of this fact.

He should (4) have complete supervision of all personnel charged with the responsibility of applying lubricants. It must be realized by industrial management that this link in the chain of lubrication is, without question, the most important. Unless "oilers" perform their duties correctly and conscientiously, all of the above plans go for naught. This may mean the establishment of a lubrication department within the company. We feel that there would be no question of the advisability of such a move providing the company is large enough to warrant the establishment of such a department.

He should (5) always be consulted on the lubrication requirements of new equipment, whether a product of the

company by whom he is employed or new equipment intended for use in their manufacturing operations. This particular responsibility is overlooked in a great majority of cases. Time after time, industrial equipment is designed without due consideration for lubricating problems imposed by the particular design. This has resulted in failure of otherwise well designed and well engineered equipment. The plant lubrication engineer should be brought into consultation while such equipment is still in the design stage since his knowledge of bearings, gears and the limitations of lubricants is of vital necessity in the proper operation of this equipment after installation.

A review of the above stated responsibilities will point out the fact that in order to perform at maximum efficiency, he must necessarily be responsible directly to top management of his company. Without this direct tie to top management, he is limited in his field of activity to the particular department to which he is assigned, whether it be engineering, maintenance, or plant operations. His scope of activity should be company wide, not department wide. His decisions on lubricants and their application must be enforceable on all other departments in the corporation and subject only to veto by top management itself.

With this type of operation, the plant lubrication engineer can unquestionably prove of tremendous value to his company and be the means of improving efficiency, reducing manufacturing costs, increasing production, and reducing costly plant breakdowns.

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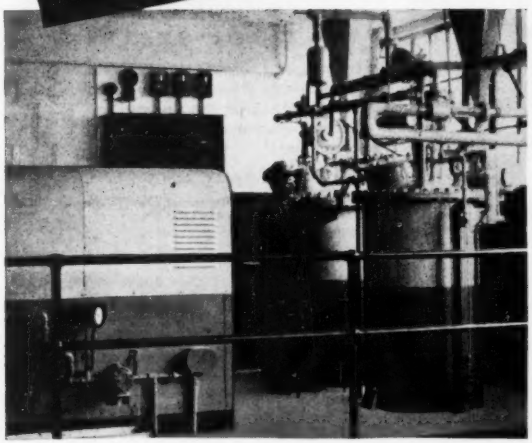
Eliminates pan cooling saves grease cooling time... eliminates batch methods



VOTATOR® Grease-making Apparatus cuts production costs, by eliminating batch methods and pan cooling. This equipment cooks and cools continuously on a 3-minute time cycle.

This fast continuous processing, applicable to many types of greases, also assures uniformity. Moisture content and temperature can be controlled accurately . . . without highly skilled operators. Only one man is required for supervision.

For time and labor savings, and better quality control, write now for case-history facts on VOTATOR Grease-making Apparatus. The Girdler Corporation, Votator Division, Louisville 1, Kentucky.

The GIRDLER Corporation
VOTATOR DIVISION

Patents and Developments

Ester Oil Grease

Inorganic gels can be used for thickening organic esters to produce waterproof greases. In U. S. Patent 2,583,604, the Canadian Honorary Advisory Committee for Scientific and Industrial Research describes a lubricating grease consisting essentially of an oily liquid ester suitable for use as a lubricant (such as dialiphatic esters of dibasic acids), 1-20 parts of a non-soap gel, and 10-100%, based on the dry weight of the gel, of a waterproofing agent such as silicone polymers or an amino silane.

Among the esters suitable as the liquid phase in such lubricants are ethylhexyl sebacate, dioctyl phthalate, triethyleneglycol-di-2-ethyl butyrate, etc. It is specified that the gel should be capable of retaining at least 100% of water, based on their dry weight, and preferably several hundred per cent. Bentonite holds about 100%, while superfine chrysotile asbestos holds about 600%.

Silica Base Greases

One advantage of silica-thickened greases is their structural stability at extremely high temperatures when soaps would melt and thus lose their body, becoming relatively fluid. However, they do possess the well-recognized disadvantage of being preferentially wet by water, thereby exhibiting bleeding under such conditions.

One way to prevent this water effect is to employ in the composition certain alkyd resins as outlined in U. S. Patent 2,583,605 issued to the Canadian Honorary Advisory Research Council for Scientific and Industrial Research. Such modified alkyds are used in proportions of 10-100%, based on the dry weight of the silica, or about 1-20% based on the grease composition. Such resins are obtained by esterifying poly acids such as phthalic, maleic or succinic, or their anhydrides, with a polyhydroxy alcohol.

A suitable waterproofing agent is a modified alkyd resin prepared from phthalic anhydride and glycerol in presence of stearic, oleic or linoleic acids, dissolved in chloroform, in an amount of 10% by weight of the dry silica aerogel (prepared according to the Kistler patent 2,260,625). The grease and resin are passed through a colloid mill to disperse the resin completely.

U. S. Patent 2,583,606, issued to the same government body, covers a lubricating grease consisting essentially of about 89% by weight of mineral base lubricating oil, 10% of silica aerogel, 1% of a hydrolyzed and polymerized aminosilane to waterproof the silica gel, and 0-.25% of water.

MALMSTROM NIMCO BRAND WOOL FAT & LANOLIN

Lubricating grease manufacturers know that top value and peak performance go hand-in-hand. That's why Malmstrom's NIMCO brands are specified. N. I. Malmstrom – largest processors of wool fat and lanolin products – produce quality components for grease production.

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America's Largest Processor of Wool Fat and Lanolin

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NEUTRAL WOOL GREASE

A small percentage of NIMCO Wool Grease Fatty Acids—naturally saturated fatty acids (free from rancidity)—gives your grease top stability, better performance. Write today for working sample.

WOOL GREASE FATTY ACIDS

Moisture	2%
Unsaponifiable (Wool Grease Alcohols)	5%
Saponifiable	95%
Free Fatty Acid (as oleic)	84%
Actual Free Fatty Acid Content	95%
Free Inorganic Acid	0.32%
Free Neutral Fat	None
Saponification Value	170
Iodine Value	25
Apparent Solidification Point (titre)	42° C.
Softening Point	45° C.
Sulphur	0.1%

A.O.C.S. Methods

Complex Soap Greases

In its U. S. Patent 2,583,607, the Canadian Honorary Advisory Council for Scientific and Industrial Research discloses a process by which voluminous precipitates of a complex structure may be converted into lubricating grease compositions by exchanging a lubricating oil for the normal water of the precipitate.

A lubricating grease of good texture and superior stability is claimed to be produced by forming a combination of salt and soap of a polyvalent metal or a complex salt which is first prepared as a voluminous aqueous precipitate, thereafter exchanging the water of the precipitate with a readily volatile oil miscible solvent, and finally replacing the solvent with lubricating oil. Such a grease is prepared from lubricating oil of 35-1000 SSU at 100° F., thickened with 5-20% by weight, based on the total composition, of the complex salt made by combining the aluminum salts of stearic and succinic acids. In molar proportions, the succinic acid should predominate, 4-10 mols of the dibasic acid per mol of fatty acid being preferred.

The use of the oil miscible solvent (acetone) is not always necessary since, if the correct ratios of acids are used, the dried soaps may be dispersed directly in oils by heating in the conventional manner. For this purpose, the molar proportions of polybasic acid should be 4-10 mols per mol of fatty acid. Water resistance may be improved by adding 0.1-2% of alkyd resin. Small amounts of lithium hydroxide can be added to the grease to neutralize any excess acidity.

Aluminum base greases prepared in this manner are claimed not only to have high melting points, but also to pass the water resistance test.

Oil Soluble Metal Soaps

A hydrous two-phase metal-acid fusion process is described in U. S. Patent 2,584,041 issued to Nuodex Products Co., for production of oil soluble soaps such as cobalt, manganese, iron, copper, zinc, lead, basic lead and lead-cobalt naphthenates; cobalt, manganese, copper, iron and basic lead tallates; cobalt, manganese, iron and lead 2-ethyl hexoates; manganese and zinc nonanoates; copper oleate, cobalt naphthenotallate, manganese naphtheno-2-ethyl hexoate, lead-cobalt naphtheno-2-ethyl hexoate, etc. It is said to be more simple, more efficient and more economical than the double decomposition method.

The method involves mixing at least one finely powdered polyvalent metal with at least one organic acid capable of forming oil-soluble heavy metal soaps, and a quantity of water to produce a reaction mass, and heating the mass to above 100° F. (say 212° F.) under conditions (of reflux) to maintain the water in its liquid phase throughout the reaction while agitating the mass.

Stabilized Silica Gel Greases

As is apparent already, there is considerable activity in the field of silica gel-thickened greases. Another patent in this field is one issued to Shell Development Co. (U. S. 2,584,-085), which covers specific silane-stabilized grease compositions.

(Continued on Page 25)

Battenfeld Grease & Oil Corp.

"Business Is Ingreasing"

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Now—One grease will service all grease applications in the majority of plants

Gives ALL THESE PLANT SAVINGS:

1. **Extends TIME between greasings**—lasts longer . . . stays in bearings longer.
2. **Low-cost application**—fewer servicings and *only the one grease* to handle.
3. **Simple inventory**—Shell Alvania Grease replaces up to 20 brands formerly required.
4. **Better protection**—against heat, cold and moisture.
5. **Greater safety**—less chance of applying the wrong grease!

Gives ALL THESE LUBRICATION ADVANTAGES:

1. **Higher mechanical stability** than any conventional grease at operating temperatures.
2. **Pumpable at low temperatures**—even in unheated storage.
3. **Stable at high temperatures**—superior to the best "soda" greases.
4. **Impervious to water**—excellent resistance to washing out.
5. **Longer service life**—reduced consumption.

The "MILLION-STROKE" Industrial Grease!

A grease that will stand 100,000 punishing strokes of the ASTM Work Tester has been considered a superior lubricant.

In a deliberate attempt to break down Shell Alvania Grease, *on the same tester* the run was extended . . . 200,000 strokes . . 300,000 strokes . . . 500,000 strokes! Finally, at one million strokes the test was discontinued, because this grease *would not break down*—it was still a fit lubricant both in appearance and consistency.

SHELL OIL COMPANY

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SHELL®

SHELL ALVANIA . . . *The "MILLION STROKE" Grease*

(Continued from Page 23)

If an undisturbed granulated mass or inorganic aerogel is exposed to the action of vaporized organosilicon halide, a suitable water-resistant grease thickener is obtained.

One specific mixture covered contains (parts by weight) mineral oil 5-20, silica aerogel 1, and dialkyldichlorosilane 0.5-5. The silane is adsorbed on the gel which is then dispersed in the oil.

High Temperature Grease

High temperature resistance under severe operating conditions ranging from 400° F. to 500° F. and higher is claimed for greases made under the Socony-Vacuum Oil Co., patent 2,585,321. In this range, most conventional greases are claimed to soften markedly and bleed away from the lubrication area. A lithium base grease containing a phosphorous or phosphoric ester is claimed to be satisfactory for such use.

The lithium soap ranges about 5-25% by weight of the finished grease (preferably 8-18%), while the phosphorus ester (such as phosphate, phosphite or thiophosphite) ranges preferably about 17-30%. Increasing the ester content tends to make the grease firmer at high temperatures in addition to the firm consistency at lower temperatures. The usual antioxidants, fillers, lead soaps, sulfurized fats, etc., also may be added.

The greases are prepared by first, dissolving the lithium soap (stearate palmitate, myristate, etc.) in mineral oil at a temperature of about 230° F. The mixture foams as the soap dissolves, indicating evaporation of water. When foaming ceases, a phosphorus ester is added and the resulting mixture is stirred and heated at 430° F. for 15-30 minutes. It is then withdrawn and run into a mold.

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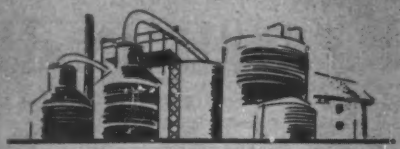
Groco 8

Red Oil (Oleic Acid)

Titre	8° - 10°C.
Cloud Point	46° - 49°F.
Color Lovibond 1" Red	4 - 8
Color Lovibond 1" Yellow	20 - 40
Unsaponifiable	2.0% max.
Saponification Value	196 - 199
Acid Value	195 - 198
% F.F.A. as Oleic Acid	98 - 99.5
Iodine Value (WIJS)	88 - 92



A. GROSS & COMPANY

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Howard Cooper

Leadership takes many forms and finds a multitude of avenues for expression. In 1946 Howard Cooper became an NLGI director where his excellent and unusual leadership found ready expression in contributions to the organization's progress. Activities that were once an idea in his mind are now a part of our program. His quick wit and balance permitted him to see all sides of a perplexing organization question and point out the logical answer.

Typical of his broad industry outlook was his paper delivered at the 1948 annual meeting urging cooperation between: designer and builder of a machine, lubricating grease manufacturer, manufacturer of the lubricating system and the operator of the machine. During the same year he was also chairman of the Membership Committee and secured more new members for the year than has ever been duplicated before or since.

In 1948 he served the industry as vice-president of the Institute and also chairman of the Program Committee. The following year he became president, where he was able to coordinate and instigate programs and activities the Institute has in progress today.

He had been ill, but had returned home from the hospital for recuperation. Everyone confidently expected him to attend the next Board of Directors meeting in September. Then came the unexpected and tragic news on June 27 that he had passed away, leaving everyone remembering his industry contributions, because of his firm belief in both industry and inter-industry cooperation.

He was manager of Sinclair's Technical Service Division of the Domestic Lubricating Sales Department, and had been an oil man for 37 years.

Born in Chicago in 1890, he was graduated from Armour Institute of Technology in 1913 with B.S. and M.E. degrees. After working as a draftsman for nine months, he took his first oil industry job with The Texas Co. in 1914 as a lubrication engineer in Chicago.

In November, 1917, he was called to Washington—an experience that was to be repeated during World War II—as a civilian in the aviation section of the signal corps in lubricants and fuels division. Later he was commissioned a first lieutenant and was waiting to sail overseas, with his orders in his pocket, when the armistice was declared.

He was discharged from the Army in December, 1918, and returned to his former job with Texaco in Chicago. For a year and a half during 1919-20, he left the company to conduct a private experimental project in connection with the development of a refrigeration unit. This didn't work out as he had hoped and in 1921 he returned to Texaco.

In November, 1922, he joined Sinclair in its Chicago headquarters as assistant chief lubrication engineer and when the company moved its home office to New York in 1924 he was transferred there and made assistant to the manager of lubricating sales. In this capacity he was assistant to the late Lloyd P. Lochridge. Along with these duties, Mr. Cooper was given the assignment of chief lubrication engineer.

The government called him to service again in April, 1942, when he became chief of the lubricants and containers section of the marketing division of PAW in Washington, a post which he held until Sept. 1, 1945, when he returned to his former job with Sinclair. He assumed the title of manager of technical service in 1949.

Mr. Cooper was a member of these technical societies: American Society of Mechanical Engineers, Society of Automotive Engineers, American Society of Lubrication Engineers and the American Society for Testing Materials.

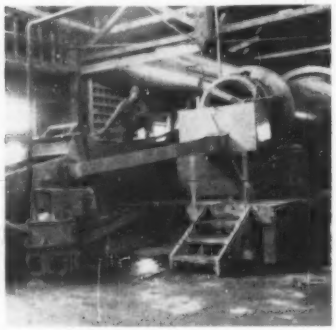
Mr. Cooper resided with his wife in Bronxville, New York.

NEW MEMBER

Metalloy Joins NLGI

During the last three years the element lithium has become extremely important to the lubricating grease industry. Prior to World War II the element had no industrial importance worth mentioning. Military uses therefore gave impetus to the establishment of the lithium industry.

Metalloy Corporation, the predecessor of Lithium Corporation of America, Inc., was established in Minneapolis as a producer of lithium chloride in 1942, and began actual production in 1943. At first lithium chloride required for military uses and lithium carbonate from which the chloride is derived were the only products of this plant. Later, step by step, other products were added until today, 14 different salts of lithium, six forms of lithium metal and two compounds made from the metal are produced in this plant.



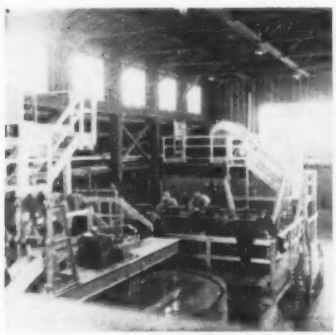
ROD MILL AND CLASSIFIER

One of the most important compounds, of course, is lithium hydroxide, monohydrate, which has become so important to the lubricating grease industry. Up to a year ago, this has been a product of secondary importance as a production item. With the increasing demand for multi-purpose lithium greases, production of lithium hydroxide has become of major importance and manufacturing facilities are being expanded to meet the ever-increasing demand.

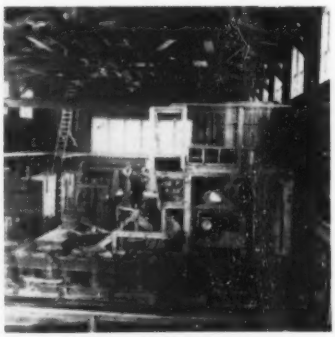
Lithium Corporation of America, Inc., of which Metalloy Corporation is the wholly-owned manufacturing subsidiary, is a complete producing entity, from crude ore to finished products. The source of the lithium is the mineral spodumene—a lithium aluminum silicate containing a maximum of 8% Li_2O. As mined the Li_2O content of the ore is only about 1.1%. After concentration, removal of gangue, etc., the concentrates contain from 5.5 to 6% Li_2O. The principal workable deposits are found in South Dakota, North Carolina, Montana, and Quebec. For the past nine years, Lithium Corporation has been developing several deposits in the Black Hills area of South Dakota, although it holds reserves in the other areas of North America mentioned above.

The process of extracting lithium from its ore and converting it to lithium hydroxide is a complicated one. The ore is mined by either surface or deep shaft methods, depending upon the nature of the deposit. After mining, the crude ore is trucked to the newly erected flotation plant at Hill City, South Dakota. Preliminary crushing and grinding is followed by froth flotation for concentrating the spodumene.

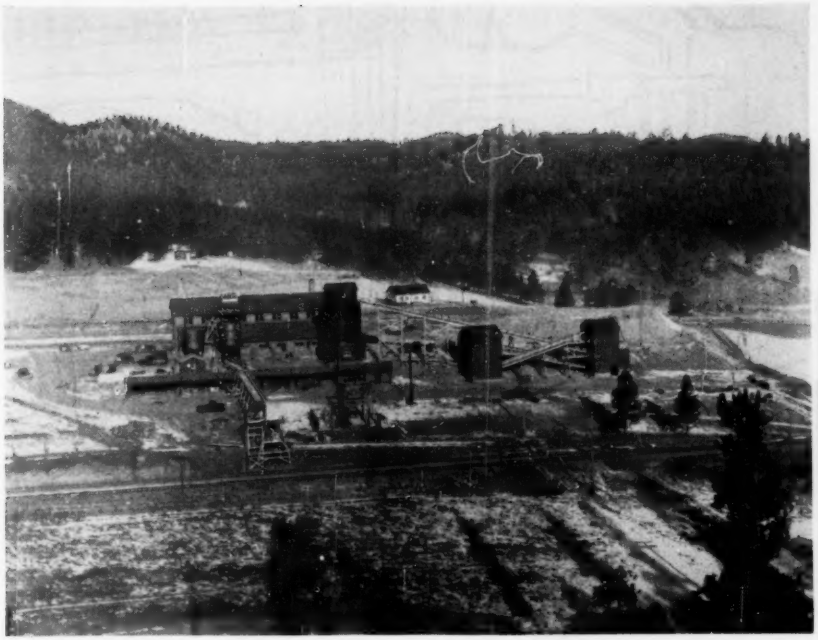
The ore concentrates now containing between 5.5 and 6% Li_2O are shipped in bulk cars to the company's chemical processing plant at Minneapolis. Here again it is necessary to go through a complicated series of operations to extract the lithium from the ore and convert it to useful compounds. Briefly, the process consists of heating the concentrated ore in a rotary kiln, then reacting with sulfuric acid to convert the lithia to lithium sulfate. Then comes a series of operations such as digesting, filtration, treatment for removal of impurities until finally a reasonably pure solution of lithium sulfate is obtained. This is then reacted with soda ash to produce lithium carbonate, the first salable product from the operation.



HYDROSEPARATOR, FLOTATION CELLS, DRYER ROOM AND FILTER IN THE BACKGROUND



FLOTATION CELLS AND CONDITIONERS



COMPLETE VIEW OF NEW ORE FLOTATION MILL AT HILL CITY, SOUTH DAKOTA

However, lithium carbonate is insoluble in water, whereas the lubricating grease industry requires a soluble salt. It therefore becomes necessary to convert the lithium carbonate to lithium hydroxide. This change is effected by reacting lithium carbonate with lime to form lithium hydroxide and calcium carbonate. (A more detailed description of this process is to be found in an article in the December issue of *Industrial & Engineering Chemistry* Vol. 43, 2636, December 1951.)

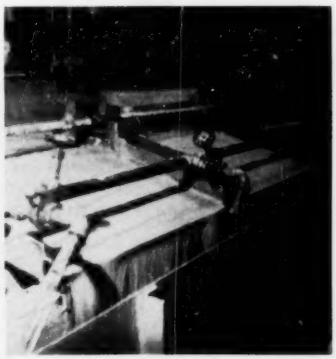
While the chemical operations at Minneapolis are extensive, nevertheless, they constitute only a part of Lithium Corporation's overall structure.

For example, the low concentration of lithium in native ores makes it necessary to maintain a constant exploration program to seek out new ore bodies.

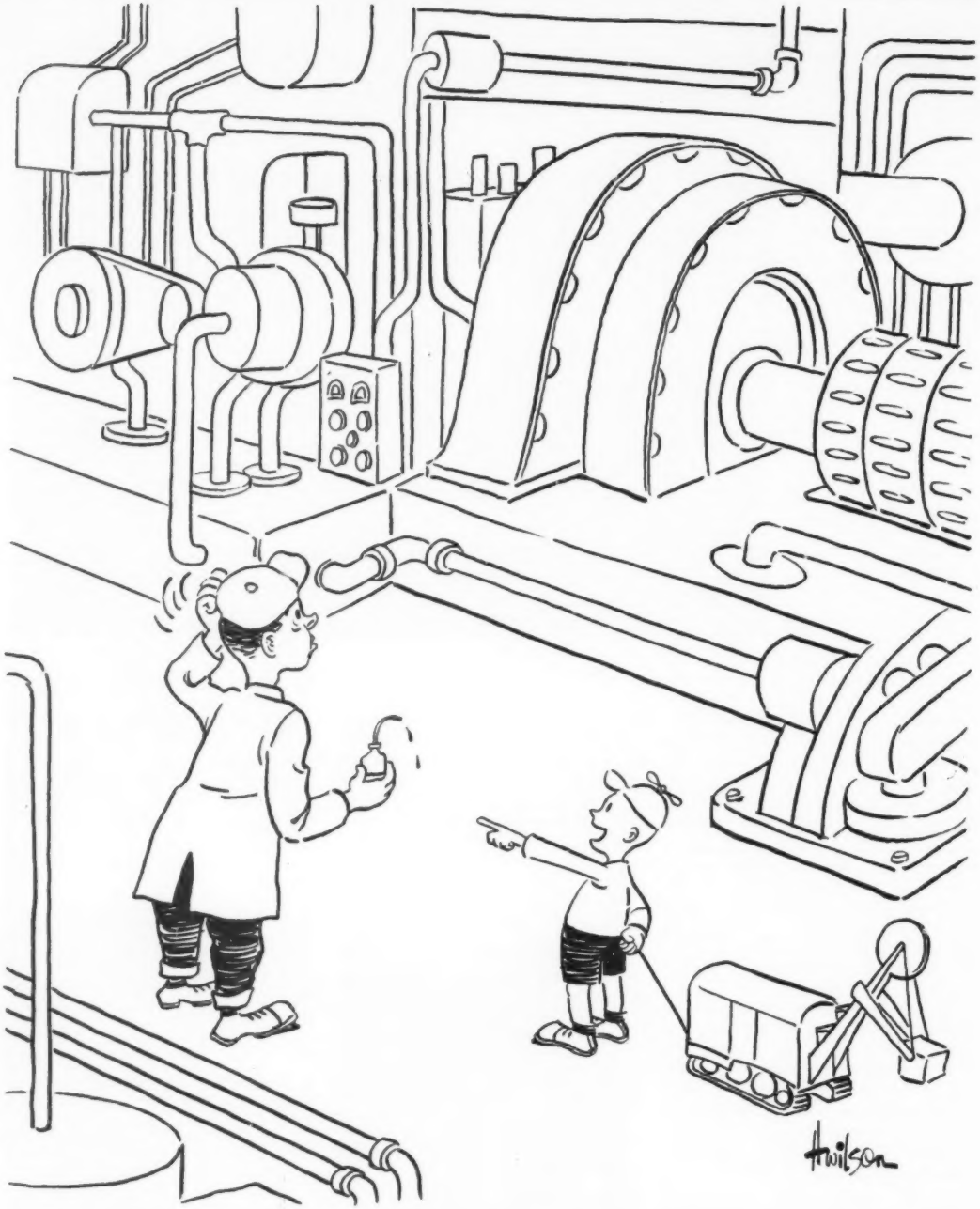
Lithium hydroxide contains 35.6% Li_2O, while the heads, or run-of-mine ore before concentration averages 1.1% Li_2O. It is estimated that the demand by the lubricating industry for 1952 is in excess of 500 tons of lithium hydroxide. To supply 500 tons of lithium hydroxide a year it is necessary to mine and concentrate 23,000 tons of run-of-mine ore. This will yield about 4000 tons of concentrates containing 5.5% Li_2O. This in turn is treated to rever 500 tons lithium hydroxide, monohydrate.

Existing facilities of Lithium Corporation appear inadequate in the face of rapidly increasing demands for lithium for multi-purpose grease. A $650,000 expansion program is being completed, which covers both additions to the chemical plant at Minneapolis and a new flotation mill at Hill City, South Dakota. In the light of new and greater demands for lithium it becomes apparent that still further expansion will be necessary.

WATER TREATMENT PLANT



FINAL OPERATIONS— SPODUMENE CONCENTRATES COMING FROM FLOTATION CELLS



"Have You Considered Attending the NLGI Annual Meeting at the Edgewater Beach Hotel in Chicago, October 27-29?"

(Get your reservations in now! Rooms are going fast.)

PEOPLE in the Industry

Changes Announced By Deep Rock Oil Corp.

W. W. Rice, manager of Deep Rock Oil Corporation's industrial sales department, has been transferred from Chicago to the company's headquarters in Tulsa, W. M. Murray, manager, general products sales department recently announced. His new office is in the Atlas Life building.

J. F. Hansen, assistant manager of the department, remains at the Chicago office, 616 S. Michigan Avenue, to service customers in the East and Midwest. W. R. Seuren, sales representative for the North Central U. S. and Canadian areas, is also located in the Chicago office.

Formerly known as special products, the department handles the sales of industrial petroleum products on a nationwide basis.

J. W. Hudson has been named superintendent of drilling and A. L. Rhodes becomes superintendent of production in changes recently announced by Carl Houy, vice-president, Deep Rock Oil Corp.

Donald K. Auld, formerly chief engineer for the Eastern Kansas district, has been named superintendent replacing Mr. Rhodes. It was also announced that James M. Moore, former operations analyst, has been named office manager in the production division's Tulsa headquarters.

Mr. Rhodes, formerly superintendent for Deep Rock's Eastern Kansas production district at Garnett, will move to general headquarters in Tulsa.

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SOCONY-VACUUM OIL CO., INC.

makers of

Gargoyle Industrial Oils and Greases

Emery Employee Earns Unique Distinction

Joseph Worpenberg became the first employee of Emery Industries to receive a diamond service pin in recognition of his 50 years of service with the company. Starting at the Ivorydale plant when only thirteen, Mr. Worpenberg for many of his earlier years worked side by side with his father who also has a long service record with Emery.

The presentation honoring this outstanding record was made by John J. Emery, president of the company, at a special luncheon attended also by Arthur Schubert, vice-president, John Archiable, works manager, and Ray Brauer, personnel manager at the Ivorydale plant.

Mr. Worpenberg is the dean of the "Old Timers Club" sponsored by the company for all those who receive watches in recognition of 25 years of service. A special event is being planned by the 50 "younger" members of this group, which includes Mr. Emery and Mr. Schubert, to pay special tribute to Mr. Worpenberg's 50 years of faithful service to Emery.

Clark Will Handle Kansas City Accounts For Battenfeld Grease

GORDON CLARK

Gordon Clark, sales department of Battenfeld Grease & Oil Corporation, Kansas City, Missouri, is now handling Kansas City accounts. Mr. Clark joined Battenfeld in March 1951. He spent the first few months in the grease laboratories, learning how Battenfeld greases are made.

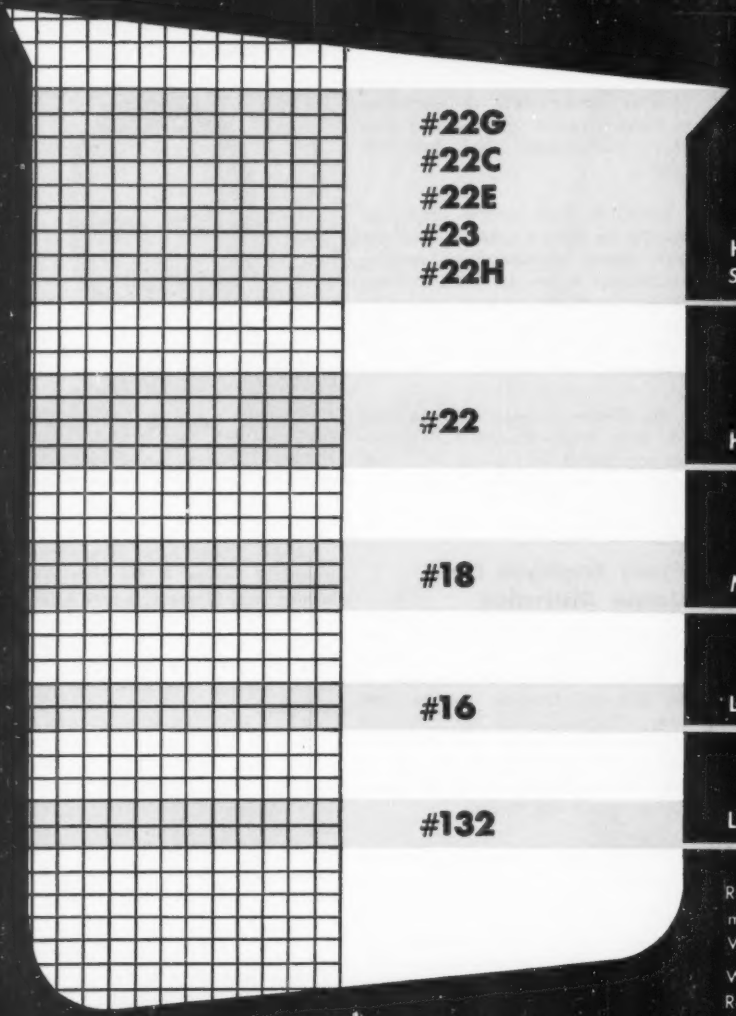
Born in Chariton, Iowa, Mr. Clark moved with his family to St. Joseph, Missouri, where he attended grade and high school. At the outbreak of World War II, he served with the Navy on the West Coast. While in the service he attended the University of Chicago, studying synthetic training devices.

After his release from the Navy, Mr. Clark entered the University of Kansas. He graduated last year with a Bachelor of Arts Degree in Chemistry.

Mr. Clark is a member of the American Chemical Society and the American Legion.

Poor communication between engineers and top management is causing estimated loss of 60 per cent of potential managerial talent of engineers, reports the National Society of Professional Engineers,

highest-gel to lowest-gel...
WITCO-made



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HOUSTON

Top Positions Given W. M. Flowers, E. J. Martin By Sinclair Research

E. J. MARTIN
Vice-President and General Manager

The promotion of W. M. Flowers to the presidency of Sinclair Research Laboratories, Inc., was announced recently in New York.

Educated at the University of Illinois, Mr. Flowers joined the Sinclair Refining Company in the cracking division of its research and development department in 1928. Since 1930 his activities have primarily concerned petroleum economics. In 1950, he left his post as director of Sinclair's economic analysis division to accept a promotion in Sinclair's New York office. He was named executive vice-president for the Sinclair Research Laboratories, Inc., in May of last year.

Mr. Flowers became well known in the petroleum industry during World War II when he played a significant role in negotiations with the Petroleum Administration for War, as well as the Rubber Reserve. He has been active in several committees of the American Petroleum Institute, of which he is a member. He also is a member of the American Association of Cost Accountants, the American Association of Management and many scientific societies.

Mr. Flowers has announced recently the promotion of E. J. Martin to the post of vice-president and general manager of Sinclair's Harvey Research Center.

Mr. Martin joined the Sinclair staff in 1929 after completion of his chemical engineering training at the University of Michigan. After about four years in Sinclair's cracking work in its development department, Mr. Martin was assigned to Sinclair's lube research division where he rose to assistant director before being promoted to his recent administrative post.

Mr. Martin has announced the promotion of C. J. Francisco to a newly created post of manager in charge of technical activities for Sinclair's Harvey research center.

Mr. Francisco joined the Sinclair organization in 1941, following completion of his graduate training at Columbia University. His initial work with the then wartime research center was with the Sinclair development department, Pilot Plant Division. He has had an important role in several phases of Sinclair research and development, and during the war years, Mr. Francisco was loaned by Sinclair for several important defense committee activities. His membership on these committees resulted in greater availability to the military of aviation fuels, explosives, and other petroleum products. At the conclusion of hostilities, he directed the activities of Sinclair's process design group and later was appointed research director of the cracking division at Sinclair's new Harvey laboratories.

New Subscriptions

Well over a hundred lubrication engineers have recently entered new subscriptions for THE INSTITUTE SPOKESMAN. One of them is J. B. Powell of the J. M. Simpson Oil Company in Amarillo. He writes us: "I enjoyed my first issue of the SPOKESMAN very much and am looking forward to the future issues."

Thank you Mr. Powell, we like to get letters like yours.

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AUTOMOTIVE LUBRICANTS • GREASES AND CUTTING OILS

PENOLA OIL COMPANY
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Morehouse Representatives Go to Mexico, Latin America

GLENN H. MOREHOUSE

Glenn H. Morehouse, partner in Morehouse Industries, Los Angeles, manufacturers of specialized processing mills, and Norman W. F. Klein, foreign sales manager, left early in May by plane on field trips to Mexico and Latin America to meet with foreign sales representatives to discuss technical developments, sales promotion and the application of Morehouse equipment to local industrial needs.

LUBRICATING GREASES

from a

CENTRAL POINT

1922

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Industry NEWS

B. K. Brown Emphasizes Need of Participation In Federal Government

Bruce K. Brown, deputy administrator for the Petroleum Administration for Defense, Washington, D. C., told the spring meeting of the division of marketing of the American Petroleum Institute at the Sheraton Plaza Hotel, Boston, that "the way to get along with and understand the federal government is to be willing to participate in it."

"The defects and failures of our government of which businessmen are apt to complain arise mostly in the administrative field," Mr. Brown said. "The bureaus need talent and they know it. The more technical their problems, whether those problems relate to petroleum, potash or parachutes, the more they need skilled personnel.

"Government doesn't need all of the two million persons working in the petroleum industry—it needs just a few of them from time to time. But I want to make an observation to those oilmen who may be lying awake nights muttering, 'what is the government going to do to petroleum next?' Unless wisdom concerning petroleum continues to be available to the government, their worst fears may eventually be realized.

"All two million may end up working for the government or — what is more likely — the industry won't be able to support two million employees."

Mr. Brown, who has spent 18 years in the petroleum industry and five in the federal government, criticized those businessmen who tend to generalize by speaking of "the government" as if it stood arrayed in battle against business, and federal employees who speak of "industry" as though it were "one cohesive thinking entity, and they decide that industry should do this, or shouldn't do that."

"Intemperate criticisms of businessmen by government officials and of government officials by businessmen tend only to widen a gap that should be narrowed," Mr. Brown asserted.

Proprietors and managers of the thousands of separate units comprising the petroleum industry already have learned "better than most businessmen, I think, how to cooperate with their government," Mr. Brown continued.

"On the average, petroleum men exhibit quite a high sense of responsibility to the public," he said. "It is well that this is true. Petroleum supplies rank just after food and shelter as necessities in the minds of most Americans. Any impairment in free ample supply is bound to evoke real protests to Congress and might result in drastic governmental intervention in fields now left open to free enterprise."

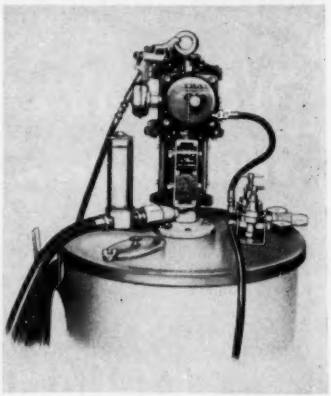
Mr. Brown said hopefully that the present era of defense mobilization will pass—and with its passage "there should be a satisfactory degree of mobilization that will avert a major war."

"When the goal is reached, there will be no need for the continuance of temporary defense mobilization agencies such as the Petroleum Administration," Mr. Brown declared. "There will be no need for fettering the petroleum industry with 'Washington directives.' However, until the Defense Production Administration, which 'divies up' materials for the military and for industry is abolished, PAD must continue—otherwise the petroleum industry will not receive sufficient materials to sustain petroleum supply. PAD cannot be abolished until the system is abolished.

"Should the transition be an unsuccessful one into a major war, it is quite obvious that there will have to be more government controls," he pointed out, "with more skilled personnel drafted into government, more trouble, more anguish. I adhere to the optimistic side. I think and pray that we can achieve powerful mobilization and avoid world catastrophe.

"The views I have expressed apply in any event—peace, mobilization or war," Mr. Brown said in conclusion. "Petroleum is too important to government to be ignored by government. Government is too important to petroleum men to be ignored by petroleum men."

Lincoln Offers New Line of Power Pumps in Catalog 40



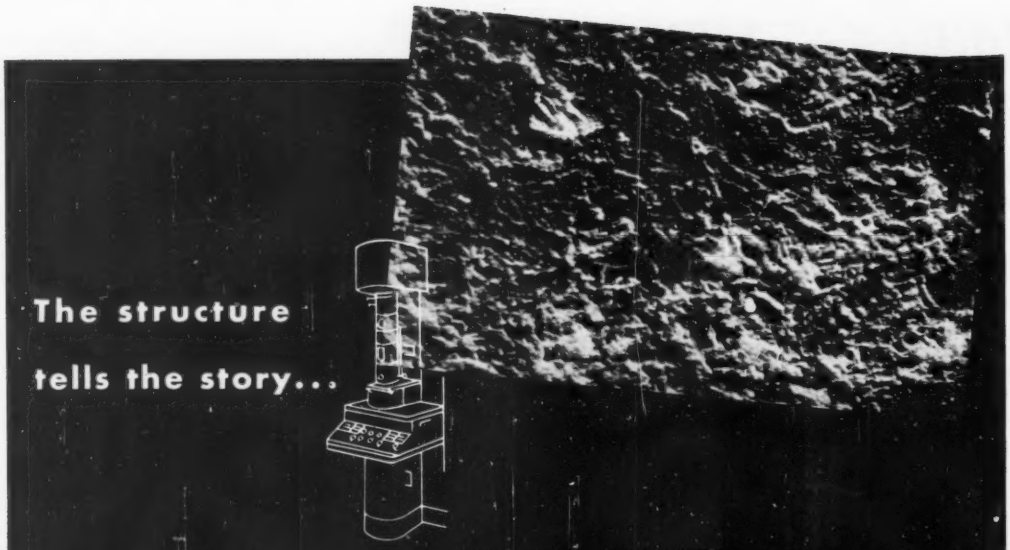
A complete line of air-motor operated pumps and accessories for automatic application of heavy to light materials, such as sealers, adhesives, roofing, waterproofing, insulating, and caulking compounds, has been announced by the manufacturer, Lincoln Engineering Co., 5702-30 Natural Bridge Avenue, St. Louis 20, Missouri.

Eleven standard models provide complete systems for spray gun, pole gun and flo-gun applications. Models are available for use with original 400-pound and 100-pound drums, and with container for 5-gallon material package.

For additional details, request Catalog 40 from the manufacturer.

Report Made on Study Of Researchers' Work Habits

Does the researcher who bosses himself contribute the most to his company? Probably, according to a study of work habits of researchers at Armour Research Foundation and Illinois Institute of Technology, reported in Chemical Engineering (March, 1952). Best producers like to set their own deadline for projects, are more active professionally. Maximum productivity was achieved with 28 hours per week of regimented work, 3.5 hours per day of related homework.



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1. **Superior gelling**
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Gives maximum gelling . . . developed for continuous grease-making equipment.

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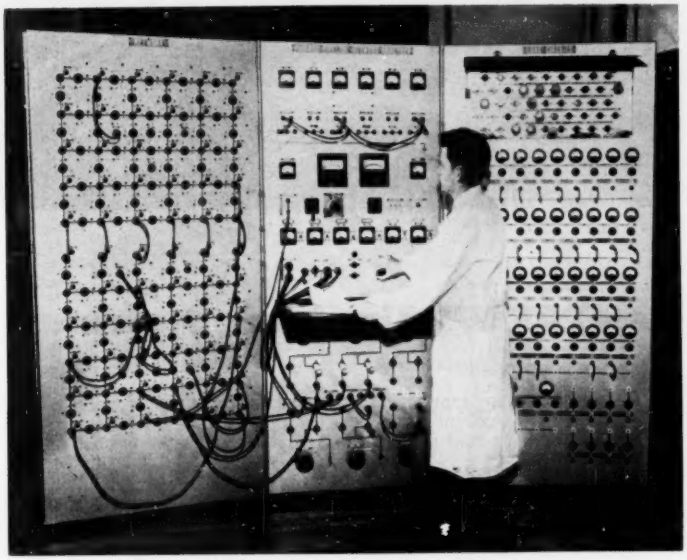
New Analyzer Helps Solve Problems in Pipeline Network Installation and Operation

Solution of problems in pipeline network installation and operation is facilitated through use of this new McIlroy Pipeline Network Analyzer by engineers at Midwest Research Institute in Kansas City. One of only three such devices in the country, the analyzer employs a unique arrangement whereby electrical current simulates actual pipeline flow.

The left-hand panel of the analyzer is designed to represent a large variety of network layouts, comprising as many as 104 pipelines. Special bulbs, called Fluistors, are installed on the reverse side of this panel and the brightness of tungsten filaments inside the bulbs indicates which pipelines are operating with the largest pressure losses. These Fluistors give quantitative values of flow and pressure drops and are constructed to represent a wide range of pipeline lengths, diameters and roughnesses.

Master instruments in the center panel indicate directly in fluid units the flow rate in any pipeline and the pressure



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With Metasap Aluminum Stearates, you can produce the *best possible grease for any grease job.*

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drop from friction between any pair of pipeline junctions. Flow rates to loads may be maintained either automatically or semi-automatically depending upon the equipment and the problem. This panel carries the controls which duplicate sources of supply, such as pumping stations and reservoirs. As many as six sources may be represented simultaneously.

The right-hand panel contains equipment to simulate 43 loads which may have any desired flow rates, and may be connected to any of the network terminals which represent pipeline junctions.

Specific applications of the analyzer include studies of industrial and municipal water-distribution systems; illuminating gas distribution systems—both high and low pressure; oil pipeline networks, district steam heating networks; and ventilation and air-conditioning systems.

Foote Increases Spodumene Holdings

Ernest G. Enck, secretary of Foote Mineral Company, announces the purchase of surface rights to approximately 37 acres of land adjoining their Kings Mountain holdings in North Carolina. This tract is a portion of the Park Yarn Mill to which the Foote Mineral Company had acquired mineral rights in October 1951. This latest acquisition will add to the already sizable deposits of high grade Spodumene which the Foote company is currently mining at this location. Spodumene is a basic raw material for the production of lithium chemicals.

Oklahoma U. Undertakes Grease Research

Methods of improving lubricating grease which may enable car owners to lengthen the period between grease jobs and which may improve the special greases required for Army tanks and Air Force jet planes are being studied at the engineering laboratories of the University of Oklahoma, it has been announced by Professor Walter J. Ewbank of the School of Mechanical Engineering.

New machinery developed by Morehouse Industries of Los Angeles, sponsors of the project and pioneer manufacturers of specialized grinding and processing mills, has been supplied to the fuels and lubricants laboratory of the university and may well prove the answer to the production problems involved, Professor Ewbank said. The current program will deal with all phases of the milling of greases in order to learn as much as possible what changes take place under such action.

First project under study is the production of lithium hydroxy stearate greases. Morehouse Model B-1405, high production grease mill, will be used in the project.

Cooperating in the project are the Cato Oil & Grease Company of Oklahoma City, the Archer-Daniels-Midland Company of Cleveland and the Foote Mineral Company of Philadelphia, that are supplying the raw materials for the manufacture of grease. The sponsors, Morehouse Industries, and the firms cooperating in the project are all members of the National Lubricating Grease Institute.

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E. T. Knight Forecasts Greater Production and Less Investment Return

America's oil industry will produce and market more petroleum products than ever before during the next 18 months, but returns on investment are set to skid, industry leaders were warned in May at Tulsa.

Speaking at the opening session of the American Petroleum Institute's Lubrication Committee meeting, E. T. Knight of the Atlantic Refining Co., forecast this pattern for petroleum's progress during 1952 and '53:

1. Increased domestic production of crude oil and natural gas liquids, plus increased imports to meet a higher total demand;

2. Larger capital expenditures in all branches of the industry to meet the higher demand and to provide at least part of the reserve capacity considered necessary for any future emergency; and

3. Dollar profits remaining at about current levels but representing a lower rate of return on investment.

Mr. Knight emphasized that the ability of the American oil industry to finance excess capacity "of the magnitude now considered vital for national defense" will depend directly on the adequacy of current and future profits.

"During the last 30 years, the expansion of the oil industry's facilities to meet an increased demand of more than five and one-half million barrels a day has been financed by self-generated funds, including funds made available by the percentage depletion allowance," Mr. Knight pointed out.

"During that period, the oil industry earned on the average, and in nearly every year, a lower rate of return on its investment than the manufacturing industry as a whole."

Mr. Knight said published estimates of various industry and government groups indicate that a desirable reserve capacity in production, refining and transportation facilities might range from 15 to 25 per cent of consumption, or "from one to two million barrels a day by the end of 1953.

"Immediate problems will arise concerning the financing of the required additional capacity as well as the maintenance of idle capacity from which no return can be expected in the near future," Mr. Knight warned.

"It is clear that current profits are neither exorbitant nor excessive in view of the important job they have to perform," the speaker affirmed.

"It is also clear that profits will have to continue at least at current rates in order to assure that the productive capacity necessary for national security will be achieved and maintained.

"I believe that the industry will be able to meet these demands if operations are not restricted by regulations which would make it impossible for the industry to fulfill its vital role in preparing for future emergencies."

"Adjustashot" Is New Valve Introduced by Alemite Div. Of Stewart-Warner Corp.

A new high pressure lubricant control valve, the "Adjustashot" (Model 7421), has just been announced by the Alemite Division of Stewart-Warner Corporation.

It provides the operator with instant choice of either full flow or a wide range of measured shots of lubricant by a simple twist of a knob. This new control valve fits any high pressure hose, regardless of make.

Light in weight, balanced and shaped to fit the hand of the operator, the valve is designed to reduce fatigue. An outstanding feature is the fact that the "Adjustashot" control valve has a built-in triple-stage strainer which removes foreign matter from the lubricant, and which may be quickly removed for cleaning without the use of any tools.

The valve has an eight-inch angled extension which makes it easier to get on and off fittings fast; a new plasticized non-skid grip; and reversible check valve seats for double life.

The adjustable shot feature of this new valve saves lubricant and promotes cleanliness. It permits the operator to avoid over-lubrication with its resultant drippage and waste of lubricant.

Model 7421 "Adjustashot" control valve is available through Alemite automotive and industrial distributors and jobbers and other lubrication equipment distribution channels.

Directory of Manufacturers Issued by Steel Shipping Container Institute, Inc.

A new directory of manufacturers covering over 90 per cent of the national production of steel shipping containers has been issued by the Steel Shipping Container Institute, Inc., 600 Fifth Ave., New York 20.

In addition to listing manufacturers, plant locations and types of containers manufactured, the DIRECTORY is replete with factual data on annual production of the various types of containers, utilization by industries and other statistics and traces the development of the industry to the present time.

Outlined are the institute-sponsored program of research and development and various current projects being carried out in cooperation with customer industries, associations and civilian and military divisions of the government —all for the ultimate purpose of providing users with the finest containers possible under best production practice, according to the institute.

API Distributes Booklet About Its Organizational Set-Up and Operations

A new booklet which explains its operations and organizational set-up has been published by the American Petroleum Institute. It is now being distributed to the membership, and other interested associations, firms and individuals.

In a brief foreward, President Frank M. Porter describes the new publication as follows:

"This booklet gives a brief summary of facts about the American Petroleum Institute—its history, aims and objectives, as well as its services to the industry.

"It should serve as a 'refresher course' for veteran institute members, and as a guide for others who desire essential information about their national trade association.

"Every eligible company and individual is invited to become a member of the institute and benefit from participation in its broad program of activities."

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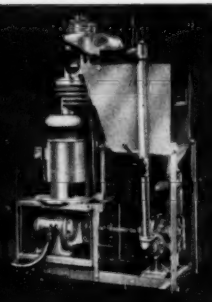
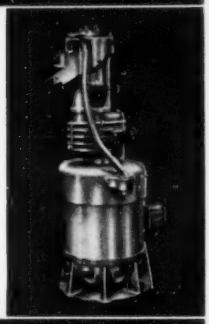


YOU CAN GET A MOREHOUSE® GREASE MILL TO MEET YOUR NEEDS



You will find the mills illustrated on this page typical of a wide range of Morehouse Speedline equipment used in processing over 100 different products for industry in more than 30 countries.

For your use in grease processing we recommend models numbered 1, 2 and 6. Deaerating equipment is available. Each mill utilizes the Morehouse principle of vertical milling by means of high-speed revolving "Carborundum" stones. Products are not contaminated during the milling operation. The models differ only in capacity, horsepower, speed, adjustment features, and auxiliary equipmment. But these differences are the things that permit a specific Morehouse mill to solve your specific processing problem.

The volume that Morehouse units give you will please you, too . . . as much as four times the volume of ordinary mills!

Each Morehouse Speedline unit is unusually compact, lightweight, easy to maintain, low in first cost, completely proved in the field, and fully guaranteed.

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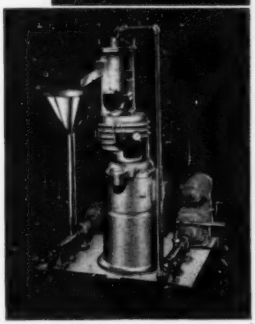

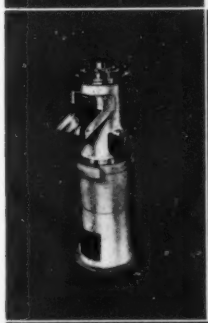

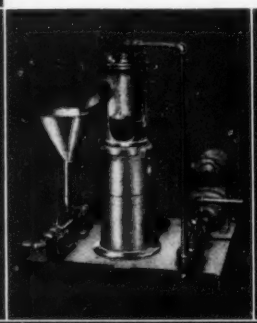

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Guide for Salesmen Prepared by Pure Oil

The purchasing department of The Pure Oil Company, Chicago, has recently distributed "The Salesman's Interview Guide."

The booklet was prepared in order to make the salesman's visit at this department as pleasent and profitable as possible. The contents of the booklet explains what is back of the Pure seal and slogan, who does Pure's buying, what they buy, and what and to whom they sell, the man you want to see and names of the buyers.

For your convenience there are sketches of the purchasing department and the area around The Pure Oil Company building. Listed also are the men to see in the division purchasing offices. At the back of the booklet is a pictorial map of producing, refining, transportation and retail marketing operations of The Pure Oil Company.

The booklet is cleverly illustrated and emphasizes the importance of suppliers for equipment and materials to The Pure Oil Company.

Stewart-Warner Corp. Makes Available Illustrated Data Sheets

Published as both a guide to specifying and to speed detailing a set of data sheets listing and illustrating all standard models of Alemite lubrication fittings has just been issued by the Alemite Division of Stewart-Warner Corporation for use by engineers, designers, draftsmen, and others.

Hydraulic, push type, pin type, button head, dot and flush type fittings are included in the data sheets. Detailed drawings, with thread and other dimensions given, are presented for each fitting, on a one-to-one scale so that, when desirable, direct tracings can be made from the sheets.

The new data sheets, Form 22-219 A-B-C & D, are available through Alemite distributors in principal cities or direct from Alemite Division, Stewart-Warner Corporation, 1826 Diversey Parkway, Chicago 14, Illinois.

A catalog of Alemite surface-check fittings and other military fittings described in accordance with MIL-STD Specifications MIL-F-3451, with all military fittings illustrated actual size and with convenient cross-reference to previous government standards, is also available. It carries Form No. 22-188.

Training Handbook Issued By Division of Marketing

The technique of training marketing personnel, and the profitable results that can be obtained from such a program, are spelled out compellingly in a new handbook issued by the Division of Marketing of the American Petroleum Institute.

Just off the press, the handbook is now available through the Institute's headquarters in New York, 50 West 50th St. It is entitled "Developing Your Men Builds Profits," and is listed as API Manual 1500. It is priced at $1.00 per copy.

In a foreword, E. J. McClanahan, chairman of the subcommittee which prepared the handbook, made these observations:

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Port Arthur, Tex.—Fort Worth, Tex.
Sweetwater, Tex.

"Here you will find general training principles, how to set up a training program, patterns of programs for all phases of petroleum marketing, and a catalog of recommended references and tested training aids.

"Regardless of whether you are an old-timer in the industry or a newcomer, whether your organization is large or small, you can use this handbook as a guide in building programs to develop your people. This should result in more efficient service to the trade, greater individual development and sustained employment, and a stable profit-earning organization."

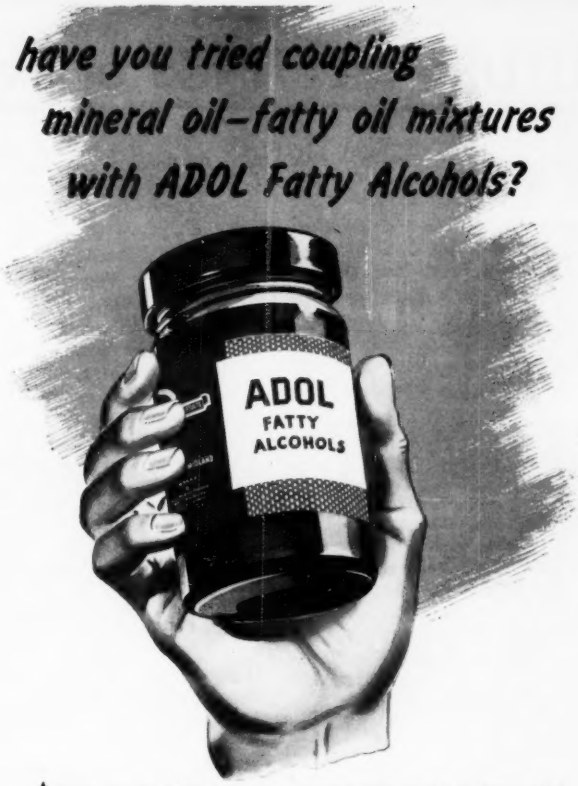
In addition to the McClanahan committee, other marketers and training specialists who helped prepare the handbook include: William Boyd, Jr., Gulf Oil Corp.; C. C. Camp, Standard Oil Company of California; E. R. Chappell, Esso Standard Oil Co.; R. F. Chase, Socony-Vacuum Oil Co.; J. S. Foster, Union Oil Company of California; E. J. Langham, Sun Oil Co.; G. A. MacFarland, The Atlantic Refining Co.; W. P. Marquam, The Pure Oil Co.; Edwin B. Stair, Shell Oil Co.; H. L. Porter, Standard Oil Company (Indiana); and L. T. White, Cities Service Co. The handbook was written by Wilford M. Aikin, author and training consultant.

The new training book is divided into two sections and covers the following contents: Part One — Training, and Good Ways of Doing It; Good Training Pays; Where You can Get Help with Your Training Job; How to Set Up a Training Program; How to Train; Training Aids and How to Use Them; Part Two—Training for Specific Aspects of Marketing; How to Manage; Bulk Plant Operations and Selling; Service Station Selling and Services.

Emphasizing the importance of trained personnel, the handbook states:

"The petroleum industry is essential to our nation in peace time and vital in time of war. At all times, the industry serves each individual citizen in scores of different ways. It heats thousands of homes, furnishes power for millions of automobiles, and keeps the wheels and gears humming smoothly throughout industry, agriculture and commerce.

"To do these things well, the industry depends upon you (the marketers) and the men you develop through training."



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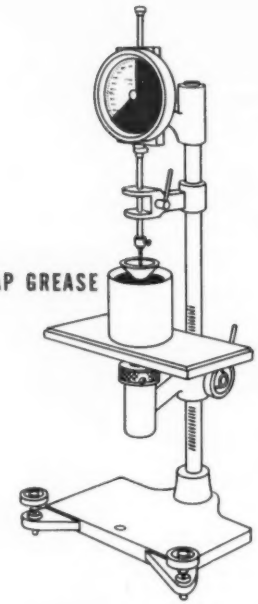

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